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VERIFIED TRANSLATION OF PRIORITY DOCUMENT

Sir:

Submitted herewith is a Verified Translation of Japanese Application Number Hei.
11-064317 filed on March 11, 1999, upon which application the claim for priority is based.

Respectfully submitted,

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DECLARATION

I, the undersigned, Masayuki ENDO, c/o NEC Patent Service, Ltd., of 1753 Shimonumabe, Nakahara-ku, Kawasaki, Kanagawa 211-8668, Japan, do hereby solemnly and sincerely declare that I am familiar with the English and Japanese languages, that I have prepared the attached English translation which is a full, true and faithful one of the patent application filed with the Patent Office of Japan under the Application No. 064317/1999 and that the present declaration is intended for use in connection with a patent application placed before the United States Patent and Trademark Office.

I further declare that all statements made herein in my own knowledge and belief are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issuing thereon.

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[Title of the Invention] ACTIVE MATRIX TYPE LIQUID CRYSTAL DISPLAY
DEVICE AND MANUFACTURING METHOD THEREOF

[WHAT IS CLAIMED IS:]

5 [Claim 1] An active matrix type liquid crystal display device
comprising:

 a first transparent substrate having:

 common electrodes and scanning lines;

 pixel electrodes and video signal lines extending in parallel

10 to common electrodes via an insulated film;

 an active element fabricated for each of a plurality of pixels
arranged in a matrix format; and

 a first alignment layer formed on the active elements;

 a second transparent substrate having:

15 a second alignment layer arranged facing each other to a
first alignment layer; and

 a light shielding film having an opening region that exposes
at least a part of the pixel electrode for each of the pixels;
and

20 spacers forming a gap for a liquid crystal composition layer
accommodated between the first and the second alignment layers,
wherein

 first projections for preventing spacers from moving are
fabricated in the vicinity of signal lines, the scanning lines,
25 or thin film transistors on the first transparent substrate.

 [Claim 2] An active matrix type liquid crystal display device
comprising:

 a first transparent substrate having:

common electrodes and scanning lines;

pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

an active element fabricated for each of a plurality of pixels
5 arranged in a matrix format; and

a first alignment layer formed on the active element;

a second transparent substrate having:

a second alignment layer arranged facing each other to a first alignment layer; and

10 a light shielding film having an opening region that exposes at least a part of the pixel electrode for each of the pixels; and

spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers,

15 wherein

second projections for preventing spacers from moving are fabricated in the vicinity of signal lines, the scanning lines, or thin film transistors on the second transparent substrate.

[Claim 3] The active matrix type liquid crystal display
20 device according to Claim 1 or 2, wherein

while the first or second projections are fabricated in a light shielded region other than the opening region, a height thereof is set narrower than a gap of the signal lines, the scanning lines, or the thin film transistor area, and furthermore, a width
25 thereof is set smaller than a diameter of spacers.

[Claim 4] The active matrix type liquid crystal display device according to Claims 1 to 3, wherein a difference between a gap by the first or the second projections, and the gap on the

signal lines, the scanning lines, or the thin film transistors is set equal to or more than 1% of the diameter of spacers.

[Claim 5] The active matrix type liquid crystal display device according to Claim 1, wherein the second projections are
5 fabricated on the second transparent substrate.

[Claim 6] The active matrix type liquid crystal display device according to Claim 5, wherein a difference between the gap by the first and the second projections and the gap on the signal lines, the scanning lines, or the thin film transistors is set
10 equal to or more than 1% of the diameter of spacers.

[Claim 7] The active matrix type liquid crystal display device according to Claim 6, wherein the first and the second projections are arranged facing each other.

[Claim 8] An active matrix type liquid crystal display device
15 comprising:

a first transparent substrate having:

common electrodes and scanning lines;

pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

20 an active element fabricated for each of a plurality of pixels arranged in a matrix format; and

a first alignment layer fabricated on the active element;

a second transparent substrate having:

a second alignment layer arranged facing each other to a
25 first alignment layer; and

a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels; and

spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers,

wherein a film thickness of the common electrodes in the vicinity of signal lines, the scanning lines, or thin film transistors on the first transparent substrate is set so that a gap on the common electrode may become narrower than a gap on the signal lines, the scanning lines, or the thin film transistors.

[Claim 9] An active matrix type liquid crystal display device comprising:

- 10 a first transparent substrate having:
 - common electrodes and scanning lines;
 - pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;
 - an active element fabricated for each of a plurality of pixels
- 15 arranged in a matrix format; and
 - a first alignment layer fabricated on the active element;
 - a second transparent substrate having:
 - a second alignment layer arranged facing each other to a first alignment layer; and
- 20 a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels;
- and
- spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers,
- 25 wherein walls for preventing spacers from moving are fabricated on an interlayer insulating film on the first transparent substrate.

[Claim 10] The active matrix type liquid crystal display

device according to Claim 8 or 9, wherein a difference between a gap on the common electrodes, and a gap on signal lines, the scanning lines, or thin film transistors is set equal to or more than 1% of a diameter of spacers.

5 [Claim 11] A method of manufacturing an active matrix type liquid crystal display device comprising:

 a first step for fabricating common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

10 a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

 a third step for forming a first transparent substrate by fabricating a first alignment layer on the active element;

 a fourth step for arranging a second alignment layer facing
15 to the first alignment layer;

 a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrode for each of the pixels to form a second transparent substrate;

 a sixth step for arranging spacers between the first and
20 the second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

 a seventh step for forming first projections for preventing the spacers from moving in the vicinity of the signal lines, the scanning lines, or thin film transistors of the first transparent
25 substrate.

 [Claim 12] A method of manufacturing an active matrix type liquid crystal display device comprising:

 a first step for forming common electrodes, scanning lines,

and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

5 a third step for forming a first transparent substrate by forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing to the first alignment layer;

10 a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrode for each of the pixels to form a second transparent substrate;

a sixth step for arranging spacers between the first and second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

15 a eighth step for forming second projections for preventing movement of the spacers in the vicinity of the signal lines, the scanning lines, or thin film transistors of the second transparent substrate.

[Claim 13] The method of manufacturing an active matrix type liquid crystal display device according to Claim 11 or 12, wherein

20 the seventh or the eighth step include:

a step for forming the first or the second projections in a light shielded region other than in the opening region;

25 a ninth step for forming the first and the second projections so that they may have a height narrower than a gap of the signal line, the scanning lines, or the thin film transistor area; and

a step for forming a width of the first and the second projections smaller than a diameter of spacers.

[Claim 14] The method of manufacturing an active matrix type liquid crystal display device according to Claim 13, wherein the ninth step includes a step for setting a difference between a gap by the first or the second projections, and a gap on the signal
5 lines, the scanning lines, or the thin film transistors equal to or more than 1% of a diameter of spacers.

[Claim 15] The method of manufacturing an active matrix type liquid crystal display device according to Claim 11, wherein the seventh step includes a tenth step for forming the second
10 projections on the second transparent substrate.

[Claim 16] The method of manufacturing an active matrix type liquid crystal display device according to Claim 15, wherein the tenth step includes a step for setting a difference between a gap by the first and second projections, and a gap on the signal line,
15 the scanning lines, or the thin film transistors equal to or more than 1% of a diameter of spacers.

[Claim 17] The method of manufacturing an active matrix type liquid crystal display device according to Claim 15, wherein the tenth step includes a step for forming the first and the second
20 projections facing each other.

[Claim 18] A method for manufacturing an active matrix type liquid crystal display device comprising:

a first step for forming common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel
25 to common electrodes via an insulated film;

a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

a third step for forming a first transparent substrate by

forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing to the first alignment layer;

a fifth step for forming a light shielding film having an opening area that exposes at least a part of the pixel electrodes for each of the pixels to form a second transparent substrate;

a sixth step for arranging spacers between the first and second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

the eleventh step for setting a film thickness of the common electrode in the vicinity of a signal lines, the scanning lines, or thin film transistors on the first transparent substrate so that a gap on the common electrode may have a thickness narrower than a gap on the signal lines, the scanning lines, or the thin film transistors.

[Claim 19] A method for manufacturing an active matrix type liquid crystal display device comprising:

a first step for forming common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

a third step for forming a first transparent substrate by forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing to the first alignment layer;

a fifth step for forming a light shielding film having an opening area that exposes at least a part of the pixel electrodes

for each pixel to form a second transparent substrate;

a sixth step for arranging spacers between the first and the second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

5 a twelfth step for forming walls for preventing the spacers from moving to the interlayer insulating film on the first transparent substrate.

[Claim 20] The method of manufacturing an active matrix type liquid crystal display device according to Claim 18 or 19, wherein
10 the eleventh or the twelfth step includes a step for setting a difference between a gap on the common electrodes, and a gap on the signal lines, the scanning lines, or the thin film transistors equal to or more than 1% of a diameter of spacers.

[Claim 21] The method of manufacturing an active matrix type liquid crystal display device according to Claim 11, wherein the
15 seventh step includes a step forming the first projections using metal materials or insulating materials simultaneously with the first to the sixth steps.

[Claim 22] The method of manufacturing an active matrix type liquid crystal display device according to Claim 11, wherein the
20 seventh step includes a step for forming the first projections with resins after termination of the first to the sixth steps.

[Claim 23] The method of manufacturing an active matrix type liquid crystal display device according to Claim 12, wherein the
25 eighth step includes a step for forming the second projections by a colored layer or an over-coating film.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The present invention relates to an active matrix type liquid crystal display device and its manufacturing method.

[0002]

5 [Prior Art]

TN (twisted nematic) mode is one of current modes used for liquid crystal display devices. In this mode, an electric field vertical to a surface of a substrate is used to orient a liquid crystal molecule director (molecular major axis). Thus, optical
10 transmittance is controlled so that an image can be displayed on the liquid crystal display panel. These are common types (hereafter called a vertical electric field driver-type) of liquid crystal display devices.

[0003]

15 In the vertical electric field driver-type liquid crystal display, however, the director is oriented to be vertical to the surface of the substrate when electric field is applied. Variations in refractive index based on viewing angles strengthen viewing angle dependency, and thereby the vertical electric field
20 driver-type liquid crystal display is not suitable when a wide viewing angle is needed.

[0004]

On the other hand, there are also liquid crystal display devices where a liquid crystal director is oriented parallel to
25 a surface of a substrate. These are devices where an electric field functions in a direction parallel to the surface of the substrate so that the director can rotate in a plane parallel to the surface of the substrate. Thereby optical transmittance is

controlled to display an image. This type (hereinafter called a lateral electric field driver-type) of liquid crystal display device has only just been developed in recent years.

[0005]

5 With the lateral electric field driver-type liquid crystal display, because the change in refractive index due to the viewing angle is remarkably small, a high quality display with wide view can be obtained.

[0006]

10 Figs. 15 to 17 show an example of this type of lateral electric field driver-type liquid crystal display. Fig. 15 is a plan view of a lateral electric field driver-type liquid crystal display, Fig. 16 is a cross-sectional view of the lateral electric field driver-type liquid crystal display in Fig. 15 taken along a line
15 J-J', and Fig. 17 is a cross-sectional view of the lateral electric field driver-type liquid crystal display in Fig. 15 taken along a line K-K'.

[0007]

20 A pixel shown in these diagrams is formed of the following elements: a signal line 1, a scanning line 2, a thin film transistor 3, a common electrode 4, and a pixel electrode 5. The scanning line 2 is connected to an external drive circuit (not shown in the figures). The thin film transistor 3 is a switching element.

[0008]

25 The scanning line 2 and the common electrode 4 are both structured on a TFT side glass substrate 10 on a side of a TFT side substrate. The pixel electrode 5 and the signal line 1 are structured on the scanning line 2 and the common electrode 4 via

an interlayer insulating film 7. The pixel electrode 5 and the common electrode 4 are alternately positioned.

[0009]

These electrodes are covered with a protection/insulation film 8. On the protection/insulation film 8, a TFT side alignment layer 15, which will be necessary to orient a liquid crystal 18, is laid and further subjected to a rubbing treatment. Thus, TFT side substrate is formed.

[0010]

A black matrix 9 to shield light is structured in a matrix format on the opposite facing glass substrate 11 on an opposite facing substrate side. First and second colored layers 12 and 13, which are necessary for color display, are prepared on the black matrix 9. Since each pixel has different colored layers of RED, GREEN, and BLUE here, there is shown by dividing into the first colored layer 12 and the second colored layer 13.

[0011]

On top of the first and second colored layers 12, 13, an over-coating film 14 necessary to make the opposite facing substrate flat is prepared. An alignment layer 16, which will be necessary to orient a liquid crystal 18, is applied on the over-coating film 14 and then subjected to a rubbing treatment. The rubbing treatment is performed in a direction opposite to that performed on top surface of the TFT substrate. Thus, opposite facing substrate is formed.

[0012]

Liquid crystal 18 and spacers 17 are enclosed between the TFT side substrate and the opposite-facing substrate. Spacers

17 are arranged randomly between both of the substrates. A gap between both of the substrates is determined by a diameter of the spacer 17 and a location giving a highest wall on both substrates.

[0013]

5 TFT side polarizer film (not shown in the figures) is attached on a surface with no electrode patterns of TFT side glass substrate 10 formed thereon. A transmission axis of the TFT side polarizer film is attached so that it may intersect perpendicularly to a direction of the rubbing. An opposite side polarizer film (not
10 shown) is attached on a surface of the opposite side glass substrate 11 where various patterns do not exist. Moreover, a transmission axis of the opposite side polarizer film is attached so that it may intersect perpendicularly to a direction of a transmission axis of the TFT side polarizer film.

15 [0014]

Thus a liquid crystal display panel is completed. The completed liquid crystal display panel is set up on a backlight, and is attached to a drive circuit.

[0015]

20 [Problem the Invention is to Solve]

In the above mentioned conventional liquid crystal display device, the liquid crystal sandwiched in a narrow gap between the TFT side substrate and an opposite facing substrate is normally oriented parallel to a direction that the rubbing treatment was
25 performed on the TFT side alignment layer 15 and the opposite facing alignment layer 16.

[0016]

As shown in Fig. 18, liquid crystal molecules 20 surrounding

each spacer 17 are oriented parallel to a surface of the spacer 17.

[0017]

In this case, in normally black mode, light permeates through an area where the liquid crystal molecules 20 are lined up askew to an absorption axis of a polarizer film (not shown). Due to this phenomenon, a leakage of light 21 develops in fan blade-shaped regions. In addition, weak aligning force causes alignment of the liquid crystal molecular 20 surrounding the spacers 17 to fall into disorder. In this case, an amount of leakage of the light 21 around the spacers 17 increases, subsequently, as shown in Fig. 19, a doughnut-shaped region of leakage of light 21 is demonstrated.

[0018]

Furthermore, when the liquid crystal panel happens to be impacted, the spacer 17 becomes charged by friction caused by friction against an alignment layers on the TFT side substrate and an opposite facing substrate respectively. Then, a radial electric field develops around the spacers 17. In this case, because the liquid crystal molecules 20 become aligned parallel to the electric field, fan blade-shaped regions of leakage of light 21 develop, as shown in Fig. 20.

[0019]

Here, when comparing two cases where the liquid crystal molecules 20 are aligned around the spacer 17 as shown in Fig. 18 and where the spacer 17 has been charged up to give a radial alignment of the liquid crystal molecules 20 as shown in Fig. 20, it is apparent that the latter case gives larger radial areas of leakage of light 21.

[0020]

This type of charging occurs when a certain pressure or impact, which happens to hit the liquid crystal display panel, causes spacers 17 that are positioned in an light shielded region easily
5 to move to a transparent region. That is, since a signal line 1, a scanning line 2, a thin film transistor 3, and a black matrix 9 of an opposite facing substrate are arranged in the light shielded region, a gap given here is narrower than a gap in the transparent regions.

10 [0021]

Therefore, since spacers 17 arranged here supports the TFT side substrate and the opposite facing substrate at a large percentage, a largest load is applied to the spacers 17. For this reason, a pressure and impact applied to a liquid crystal panel
15 easily move the spacers 17 arranged in the light shielded region out into the transparent region.

[0022]

On the contrary, since the transparent region has a comparatively large gap, it is rare that pressure and impact applied
20 to the liquid crystal panel move the spacers 17 out into the light shielded region having a narrow gap.

[0023]

Moreover, as shown in Fig. 18, the liquid crystal molecules
20 around the spacers 17 are oriented parallel to a surface of the spacers 17. For this reason, movement of the spacers 17 to
25 the transparent region disturbs orientation of the liquid crystal molecule 20 around the spacers 17, or often gives charge up, which leads to remarkable leakage of light 21 around the spacers 17.

[0024]

As described above, when a certain pressure or impact is applied to the liquid crystal display panel, spacers 17 that are positioned within a light shielded region can easily migrate to a transparent region, and particularly in black display, increase in leakage of light 21 of the spacers 17 becomes remarkable. Besides, when distribution of the spacers 17 is not uniform, display quality becomes distorted and a problem develops where decrease in contrast caused by increase in black brightness is observed. In particular, there has been observed faults caused by the leakage of light 21, when vibration or impact was applied after inspection immediately after manufacturing of an active matrix type liquid crystal display device.

[0025]

The present invention has been developed taking the above problems into consideration, comprising an active matrix liquid crystal display device and its manufacturing method, which have been made so that an amount of leakage of light is reduced and display quality is improved to avoid moving of spacers into a transparent region when the device is shaken or impacted.

[0026]

[Means to Solve the Problem]

An active matrix type liquid crystal display device according to Claim 1 is characterized in that an active matrix type liquid crystal display device comprising:

- a first transparent substrate having:
- common electrodes and scanning lines;
- pixel electrodes and video signal lines extending in parallel

to common electrodes via an insulated film;

an active element fabricated for each of a plurality of pixels arranged in a matrix format; and

a first alignment layer fabricated on the active element;

5 a second transparent substrate having:

a second alignment layer arranged facing each other to a first alignment layer; and

a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels;

10 and

spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers, wherein

15 first projections for preventing the spacer from moving is fabricated in the vicinity of a signal line, scanning lines, or thin film transistors on the first transparent substrate.

An active matrix type liquid crystal display device according to Claim 2 is characterized in that an active matrix type liquid crystal display device comprising:

20 a first transparent substrate having:

common electrodes and scanning lines;

pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

25 an active element fabricated for each of a plurality of pixels arranged in a matrix format; and

a first alignment layer fabricated on the active element;

a second transparent substrate having:

a second alignment layer arranged facing each other to a

first alignment layer; and

a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels; and

5 spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers, wherein

a second projection for preventing the spacer from moving is fabricated in the vicinity of a signal line, scanning lines, 10 or thin film transistors on the second transparent substrate.

Moreover, while the first and the second projection may be formed in the light shielded region other than the opening region, set so as to have a height narrower than a gap of the signal line, scanning lines, or thin film transistor area, and furthermore, 15 a width may be set smaller than a diameter of the spacer.

Furthermore, a difference between a gap by the first or the second projection and a gap on a signal line, scanning lines, or thin film transistors may be set equal to or more than 1% of a diameter of the spacer.

20 And the second projection may be formed on the second transparent substrate.

Moreover, the difference between a gap by the first and the second projection and the gap on the signal line, the scanning lines, or the thin film transistor may be equal to or more than 25 1% of the diameter of the spacer.

And the first and the second projections may be arranged facing each other.

An active matrix type liquid crystal display device according

to Claim 8 is characterized in that an active matrix type liquid crystal display device comprising:

a first transparent substrate having:
common electrodes and scanning lines;

5 pixel electrodes and video signal lines extending in parallel
to common electrodes via an insulated film;

an active element formed for each of a plurality of pixels
arranged in a matrix format; and

a first alignment layer formed on the active element;

10 a second transparent substrate having:

a second alignment layer arranged facing each other to a
first alignment layer; and

a light shielding film having an opening region that exposes
at least a part of the pixel electrodes for each of the pixels;

15 and

spacers forming a gap for a liquid crystal composition layer
accommodated between the first and the second alignment layers,
wherein

a film thickness of the common electrode in the vicinity
20 of a signal line, the scanning lines, or thin film transistors
on the first transparent substrate is set so that a gap on the
common electrode may become narrower than a gap on the signal line,
the scanning lines, or thin film transistors.

An active matrix type liquid crystal display device according
25 to Claim 9 is characterized in that an active matrix type liquid
crystal display device comprising:

a first transparent substrate having:
common electrodes and scanning lines;

pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

an active element fabricated for each of a plurality of pixels arranged in a matrix format; and

5 a first alignment layer fabricated on the active element;

a second transparent substrate having:

a second alignment layer arranged facing each other to a first alignment layer; and

a light shielding film having an opening region that exposes
10 at least a part of the pixel electrodes for each of the pixels;

and

spacers forming a gap for a liquid crystal composition layer accommodated between the first and the second alignment layers, wherein

15 walls for preventing the spacer from moving is formed on an interlayer insulating film on the first transparent substrate.

Moreover, a difference between a gap on the common electrode and a gap on the signal line, the scanning lines, or thin film transistors is set equal to or more than 1% of a diameter of the
20 spacer.

A method of manufacturing an active matrix type liquid crystal display device according to Claim 11 is characterized by comprising:

a first step for fabricating common electrodes, scanning
25 lines, and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

a second step for fabricating an active element for each of a plurality of pixels arranged in a matrix format;

a third step for fabricating a first transparent substrate by forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing to the first alignment layer;

5 a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels to fabricate a second transparent substrate;

a sixth step for arranging spacers between the first and second alignment layers to fabricate a gap for accommodating a
10 liquid crystal composition layer; and

a seventh step for fabricating first projections for preventing the spacers from moving in the vicinity of the signal line, the scanning lines, or the thin film transistor of the first transparent substrate.

15 A method of manufacturing an active matrix type liquid crystal display device according to Claim 12 is characterized by comprising:

a first step for forming common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel
20 to common electrodes via an insulated film;

a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

a third step for forming a first transparent substrate by forming a first alignment layer on the active element;

25 a fourth step for arranging a second alignment layer facing to the first alignment layer;

a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrodes

for each of the pixels to form a second transparent substrate;

a sixth step for arranging spacers between the first and the second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

5 a eighth step for forming a second projection for preventing movement of the spacers in the vicinity of the signal line, the scanning lines, or thin film transistors of the second transparent substrate.

Moreover the seventh or the eighth step may include:

10 a step for forming the first or the second projection in a light shielded region other than in the opening region;

a ninth step for forming the first and the second projections so that they may have a height narrower than a gap of a part of the signal line, the scanning lines, or the thin film transistor;

15 and

a step for forming a width of the first and the second projection smaller than a diameter of spacers.

Besides, a ninth step may include a step

for setting a difference between a gap by the first or the
20 second projection, and a gap on the signal line, the scanning lines, or the thin film transistor equal to or more than 1% of a diameter of spacers.

Moreover, the seventh step may include a tenth step for forming the second projection on the second transparent substrate.

25 Furthermore, the tenth step may include a step for setting a difference between a gap by the first and the second projections, and a gap on the signal line, the scanning lines, or the thin film transistor equal to or more than 1% of a diameter of spacers.

Besides, the tenth step may include a step for forming the first and the second projections facing each other.

A method for manufacturing an active matrix type liquid crystal display device according to Claim 18 is characterized by
5 comprising:

a first step for forming common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

a second step for forming an active element for each of a
10 plurality of pixels arranged in a matrix format;

a third step for forming a first transparent substrate by forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing to the first alignment layer;

15 a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels to form a second transparent substrate;

a sixth step for arranging spacers between the first and the second alignment layers to form a gap for accommodating a liquid
20 crystal composition layer; and

the eleventh step for setting a film thickness of the common electrode in the vicinity of a signal line, the scanning lines, or thin film transistors on the first transparent substrate so that a gap on the common electrode may have a thickness narrower
25 than a gap on the signal line, the scanning lines, or the thin film transistor.

A method for manufacturing an active matrix type liquid crystal display device according to Claim 19 is characterized by

comprising:

a first step for forming common electrodes, scanning lines, and pixel electrodes and video signal lines extending in parallel to common electrodes via an insulated film;

5 a second step for forming an active element for each of a plurality of pixels arranged in a matrix format;

a third step for forming a first transparent substrate by forming a first alignment layer on the active element;

a fourth step for arranging a second alignment layer facing
10 to the first alignment layer;

a fifth step for forming a light shielding film having an opening region that exposes at least a part of the pixel electrodes for each of the pixels to form a second transparent substrate;

a sixth step for arranging spacers between the first and
15 the second alignment layers to form a gap for accommodating a liquid crystal composition layer; and

a twelfth step for forming walls for preventing spacers from moving to the interlayer insulating film on the first transparent substrate.

20 Moreover, the eleventh or the twelfth step may include a step for setting a difference between the gap on the common electrode, and the gap on the signal line, the scanning lines, or the thin film transistor equal to or more than 1% of a diameter of spacers.

Besides, the seventh step may include a step forming the
25 first projection using metal materials or insulating materials simultaneously with the first to the sixth steps.

Furthermore, the seventh step may include a step for forming the first projection with resins after termination of the first

to the sixth steps.

Besides, the eighth step may include a step for forming the second projection by a colored layer or an over-coating film.

In an active matrix type liquid crystal display device of the present invention, and a method for manufacturing the same, the first and/or the second projections for preventing spacers from moving are formed in the vicinity of the signal line, the scanning lines, or the thin film transistor on the first and/or the second transparent substrates, and thereby moving of spacers to a transparent region are prevented, and leakage of light by the spacers is reduced.

[0027]

[Preferred Embodiment of the Invention]

Hereinafter, embodiments of the present invention will be described. In order to omit redundant description, in Figures given below same codes will be given to items common in Figs. 15 to 20.

[0028]

(First embodiment)

Fig. 1 is a plan view of an active-matrix liquid crystal display, according to the first embodiment of the present invention, Fig. 2 is a partial cross-sectional view of the active-matrix liquid crystal display taken along a line A-A' in Fig. 1, and Fig. 3 is a partial cross-sectional view of the active-matrix liquid crystal display taken along a line B-B' in Fig. 1.

[0029]

As shown in these Figures, a TFT side projection 6 as a first projection is fabricated on a TFT side glass substrate 10. The

TFT side projection 6 prevents any spacers 17 from moving out of a light shielded region to a transparent region. The TFT side projection 6 is fabricated in the vicinity of a signal line 1, a scanning line 2, or a thin film transistor 3 on the TFT side
5 glass substrate 10.

[0030]

As shown in Fig. 2, the TFT side projection 6 is positioned on a common electrode 4 in the vicinity of the signal line 1, and is further formed in a region overlapping with a black matrix 9
10 with a metal pattern.

[0031]

The TFT side projection 6 may simultaneously be made of a metal material such as Cr, Al, or Mo, or an insulating material such as SiO_2 or SiNx . Alternatively, the TFT side projection 6
15 may be made of, for example, a resin and formed in other step after the TFT substrate have been fabricated.

[0032]

In addition, as shown in Fig. 2, a gap between the TFT side projection 6 and an opposite facing substrate is set narrower than
20 a gap on the signal line 1. A width of the TFT side projection 6 is set equal to or less than a diameter of a spacer 17. That is, for example, when the diameter of the spacer 17 is 4 micrometers, the width is equal to or less than 4 micrometers.

[0033]

Moreover, as shown in Fig. 3, a gap between the TFT side
25 projection 6 and the opposite facing substrate is set narrower than a narrowest gap on the thin film transistor 3. As mentioned above, the width of TFT side projection 6 is set equal to or less

than the diameter of the spacer 17.

[0034]

Here, a difference between the gap on the signal line 1, the scanning line 2, or the thin film transistor 3, and the gap
5 on the TFT side projection 6 is set equal to or more than 1%, and preferably equal to or more than 2% of the diameter of spacers. Thereby, the spacer 17 is prevented from moving over the TFT side projection 6 into the transparent region.

[0035]

10 Thus, in the first embodiment, the TFT side projection 6 is fabricated on a side of the TFT side glass substrate 10, and simultaneously the gap on the TFT side projection 6 is set narrower than the gap on the signal line 1, the scanning line 2, or the thin film transistor 3.

15 [0036]

Thereby, even if a certain pressure or impact happens to be applied onto a liquid crystal display panel, it is difficult for any spacers 17 positioned on the signal line 1, the scanning line 2, or the thin film transistor 3 to move into the transparent
20 region. Then, increase in leakage of light generated around the spacer 17 is suppressed.

[0037]

As a result, black luminance falls and while contrast is improved, display irregularity caused by distribution
25 irregularity of the leakage of light is reduced. And furthermore, the panel becomes more durable against certain vibrations and impacts. Moreover, even when vibration or impact is happened to be applied immediately after manufacturing of an active matrix

type liquid crystal display device, generation of any defects will be prevented after inspection immediately after manufacturing process.

[0038]

5 Besides, the TFT side projection 6 is not limited to be continuously fabricated as shown in Fig. 1, but it may intermittently be fabricated.

[0039]

(Second embodiment)

10 Fig. 4 illustrates a plan view of the active matrix type liquid crystal display device of the second embodiment; Fig. 5 illustrates a cross-sectional view of the active matrix type liquid crystal display device taken along a line C-C' in Fig. 4; and Fig. 6 illustrates a cross-sectional view of the active matrix type
15 liquid crystal display device taken along a line D-D' in Fig. 5.

[0040]

In the second embodiment, an opposite facing substrate side projection 19 as a second projection is structured on an opposite facing substrate side. The opposite facing substrate side
20 projection 19 is simultaneously structured in formation of a first colored layer 12 or an over-coating film 14 at the time of manufacture of the opposite facing substrate. In the second embodiment, the opposite facing substrate side projection 19 is made of material identical to that of the over-coating film 14.

25 [0041]

And the opposite facing substrate side projection 19 is structured simultaneously with the over-coating film 14 on a black matrix 9 on a side of an opposite side glass substrate 11 in the

vicinity of the signal line 1 as shown in Fig. 5. A gap on the opposite facing substrate side projection 19 is structured so that it may become narrower than a gap on the signal line. A width of the opposite facing substrate side projection 19 is set equal to or less than a diameter of the spacer 17. That is, for example, when the diameter of the spacer 17 is 4 micrometers, the width is equal to or less than 4 micrometers.

[0042]

Besides, the opposite facing substrate side projection 19 is structured on the black matrix 9 of the opposite side glass substrate 11 in the vicinity of the scanning line 2 and the thin film transistor 3, as shown in Fig. 6. A gap on the opposite facing substrate side projection 19 is structured so that it may become narrower than a gap on the scanning line 2 or the thin film transistor 3. A width of the opposite facing substrate side projection 19 is, as described above, set to be equal to or less than the diameter of the spacer.

[0043]

Here, a difference between the gap on the signal line 1, the scanning line 2, or the thin film transistor 3, and the gap on the opposite facing substrate side projection 19 is set equal to or more than 1%, and preferably equal to or more than 2% of the diameter of the spacer.

[0044]

Thus, in the second embodiment, the opposite facing substrate side projection 19 was fabricated on a side of the opposite side glass substrate 11, and simultaneously the gap on the opposite facing substrate side projection 19 was set narrower than the gap

on the signal line 1, the scanning line 2, or the thin film transistor 3.

[0045]

Thereby, even if a certain pressure or impact happens to be applied onto a liquid crystal display panel, it is difficult for any spacers 17 positioned on the signal line 1, the scanning line 2, or the thin film transistor 3 to move into the transparent region. Therefore, increase in leakage of light generated around the spacer 17 is suppressed.

10 [0046]

As a result, black luminance falls and while contrast is improved, display irregularity caused by distribution irregularity of the leakage of light is reduced. And furthermore, the panel becomes more durable against certain vibrations and impacts. Moreover, even when vibration or impact is happened to be applied immediately after manufacturing of an active matrix type liquid crystal display device, generation of any defects will be prevented after inspection immediately after manufacturing process.

20 [0047]

Besides the opposite facing substrate side projection 19 is not limited to be continuously fabricated as shown in Fig. 19, but it may intermittently be fabricated.

[0048]

25 (Third embodiment)

Fig. 7 illustrates a plan view showing the third embodiment of the active matrix type liquid crystal display device of the present invention; Fig. 8 illustrates a cross-sectional view of

the active matrix type liquid crystal display device taken along a line E-E' in Fig. 7; and Fig. 9 illustrates a cross-sectional view of the liquid crystal display taken along a line F-F' in Fig. 8.

5 [0049]

In the third embodiment, the first and the second embodiment are combined together.

[0050]

That is, a TFT side projection 6, and an opposite facing
10 substrate side projection 19 are fabricated in each of a TFT side glass substrate 10 and an opposite side glass substrate 11. The TFT side projection 6 and the opposite facing substrate side projection 19 are fabricated by methods identical to the methods shown in the first and the second embodiments.

15 [0051]

That is, as shown in Fig. 8, in a side of the TFT side glass substrate 10, the TFT side projection 6 is structured by a metal pattern in a region overlapping with a black matrix 9 of a common electrode 4 in the vicinity of a signal line 1.

20 [0052]

In a side of the opposite side glass substrate 11, the opposite facing substrate side projection 19 is structured by an over-coating film 14 on the black matrix 9 in the vicinity of the signal line 1.

25 [0053]

The TFT side projection 6 and the opposite facing substrate side projection 19 are arranged so as to face each other. A gap between the TFT side projection 6 and the opposite facing substrate

side projection 19 is set narrower than a gap on the signal line 1.

[0054]

In this case, heights of the TFT side projection 6 and the
5 opposite facing substrate side projection 19 may be half of heights
in the respective first and second embodiments.

[0055]

Besides, the TFT side projection 6 and the opposite facing
substrate side projection 19 may be arranged so as not to face
10 each other. In this case, a relative gap between the TFT side
projection 6 and the opposite facing substrate side projection
19 may just be set narrower than a gap on the signal line 1.

[0056]

Besides, widths of the TFT side projection 6 and the opposite
15 facing substrate side projection 19 are equal to or less than a
diameter of the spacer 17 as in each of the first and the second
embodiments.

[0057]

Thus the TFT side projection 6 and the opposite facing
20 substrate side projection 19 are provided on the TFT side glass
substrate 10 and the opposite side glass substrate 11, and thereby
the number of the TFT side projection 6 and the opposite facing
substrate side projection 19 may be doubled the number of those
in each of the first the second embodiment. As a result, more
25 effects of preventing the spacer 17 from moving may be expected.

[0058]

Besides, as shown in Fig. 9, the TFT side projection 6, which
is made of a metal pattern, is fabricated in a region overlapping

with the black matrix 9 of the common electrode 4 in the vicinity of the scanning line 2 and the thin film transistor 3 on a side of the TFT side glass substrate 10.

[0059]

5 On a side of the opposite side glass substrate 11, the opposite facing substrate side projection 19 is fabricated with the over-coating film 14 on the black matrix 9 in the vicinity of the signal line 1.

[0060]

10 The TFT side projection 6 and the opposite facing substrate side projection 19 are arranged facing each other. The gap between the TFT side projection 6 and the opposite facing substrate side projection 19 is set narrower than a gap on the scanning line 2 and the thin film transistor 3.

15 [0061]

 Thereby, heights of the TFT side projection 6 and the opposite facing substrate side projection 19 may be half of heights in the respective first and second embodiments.

[0062]

20 Besides, the TFT side projection 6 and the opposite facing substrate side projection 19 may be arranged so as not to face each other. In this case, a relative gap between the TFT side projection 6 and the opposite facing substrate side projection 19 may just be set narrower than the gap on the scanning line 2
25 and the thin film transistor 3.

[0063]

 Thus the TFT side projection 6 and the opposite facing substrate side projection 19 are provided on the TFT side glass

substrate 10 and the opposite side glass substrate 11, and thereby the number of the TFT side projection 6 and the opposite facing substrate side projection 19 may be doubled the number of those in each of the first the second embodiment, as described above.

5 As a result, more effects of preventing the spacer 17 from moving may be expected.

[0064]

Widths of the TFT side projection 6 and the opposite facing substrate side projection 19 are equal to or less than the diameter
10 of the spacer 17 as in each of the first and the second embodiments.

[0065]

Furthermore, as in the first embodiment, a difference between the gap on the signal line 1, the scanning line 2, or the thin film transistor 3, and the gap on the TFT side projection 6 and
15 the opposite facing substrate side projection 19 is set equal to or more than 1%, and preferably equal to or more than 2% of the diameter of the spacer.

[0066]

Thus, in the third embodiment, the TFT side projection 6
20 and the opposite facing substrate side projection 19 are fabricated on the TFT side glass substrate 10 and the opposite side glass substrate 11, the gap between the TFT side projection 6 and the opposite facing substrate side projection 19 was set narrower than the gap on the signal line 1, the scanning line 2, or the thin
25 film transistor 3.

[0067]

Thereby, even if a certain pressure or impact happens to be applied onto a liquid crystal display panel, it is difficult

for any spacers 17 positioned on the signal line 1, the scanning line 2, or the thin film transistor 3 to move into a transparent region. Then, since increase in leakage of light generated around the spacer 17 is suppressed, an active matrix type liquid crystal display device having no display irregularity and having excellent in reliability, while excelling in display properties may be obtained.

[0068]

Besides, the TFT side projection 6 and the opposite facing substrate side projection 19 may be intermittently fabricated as described above.

[0069]

(Fourth embodiment)

Fig. 10 illustrates a plan view showing an active matrix type liquid crystal display device of the present invention of the fourth embodiment; Fig. 11 illustrates a cross-sectional view of the active matrix type liquid crystal display device taken along a line G-G' in Fig. 10; whereas Fig. 12 illustrates a cross-sectional view of the active matrix type liquid crystal display device taken along a line H-H' in Fig. 11.

[0070]

In the fourth embodiment, adjustment of a wall of a TFT side substrate sets a gap on a signal line 1, a scanning line 2, or a thin film transistor 3 narrow, instead of a TFT side projection 6 and an opposite facing substrate side projection 19 in the first to third embodiments.

[0071]

That is, a film thickness of a common electrode 4 in the

vicinity of the signal line 1, the scanning line 2 or the thin film transistor 3 is increased, and made narrower than a gap on the signal line 1, the scanning line 2, or the thin film transistor 3.

5 [0072]

Besides, a gap on the common electrode 4 is made narrower than the gap on the signal line 1 as shown in Fig. 11. Furthermore the gap on the common electrode 4 is made narrower than a gap on the scanning line 2 and the thin film transistor 3 as shown in
10 Fig. 12.

[0073]

Here, as described above, a difference between the gap on the signal line 1, the scanning line 2, or the thin film transistor 3, and the gap on common electrode 4 is set equal to or more than
15 1%, and preferably equal to or more than 2% of a diameter of the spacer. Thereby, movement of the spacers 17 into a transparent region is prevented.

[0074]

Thus, in the fourth embodiment, since the gap of the common
20 electrode 4 area was made narrower than that of the signal line 1, the scanning line 2, or the thin film transistor 3 area, prevention effect of moving of the spacer 17 into the transparent region is improved. In addition, in the fourth embodiment, since fabrication of the TFT side projection 6 and the opposite facing
25 substrate side projection 19 in the first to third embodiments becomes unnecessary, manufacturing processes will be shortened.

[0075]

Thereby, even if a certain pressure or impact happens to

be applied onto a liquid crystal display panel, it is difficult for any spacers 17 positioned on the signal line 1, the scanning line 2, or the thin film transistor 3 to move into a transparent region. Then, since increase in leakage of light generated around the spacer 17 is suppressed, an active matrix type liquid crystal display device having no display irregularity and having excellent in reliability, while excelling in display properties may be obtained.

[0076]

10 (Fifth embodiment)

Fig. 13 illustrates a plan view showing the fifth embodiment of an active matrix type liquid crystal display device of the present invention, whereas Fig. 14 illustrates a cross-sectional view of the active matrix type liquid crystal display device taken along a line I-I' in Fig. 13.

[0077]

In the fifth embodiment, adjustment of a wall of a TFT side substrate sets a gap on a common electrode 4 in the vicinity of a signal line 1 narrower as in the fourth embodiment.

20 [0078]

That is, a technique, such as etching, is used to an interlayer insulating film 7 under the signal line 1 to fabricate an interlayer insulating film wall 22. Thereby, the gap on the signal line 1 is extended and a same effect as described above may be demonstrated. At this time, there is no necessity that whole of the interlayer insulating film 7 is removed, in fabrication of the interlayer insulating film wall 22.

[0079]

Besides, the gap on the common electrode 4 is narrower than the gap on the signal line 1, as shown in Fig. 14. Here, a difference of the gap on signal line 1, and the gap the on common electrode 4 is equal to or more than 1%, and preferably equal to or more than 2% of a diameter of the spacer 17.

[0080]

Thus, in the fifth embodiment, the gap on the common electrode 4 is set narrower than the gap on the signal line 1. Thereby, since the gap on the common electrode 4 is narrowed, the spacer 17 may be prevented from moving into the transparent region.

[0081]

Thereby, even if a certain pressure or impact happens to be applied onto a liquid crystal display panel, it is difficult for any spacers 17 positioned on the signal line 1, the scanning line 2, or the thin film transistor 3 to move into a transparent region. Then, since increase in leakage of light generated around the spacer 17 is suppressed, an active matrix type liquid crystal display device having no display irregularity and having excellent in reliability, while excelling in display properties may be obtained.

[0082]

Besides, in each of the above embodiments, although a description is given for a case where an active matrix type liquid crystal display device of the present invention is applied to an active matrix type TFT liquid crystal display by a lateral electric field method, not only limited to this example, but the present invention may be adapted also to other liquid crystal display devices, such as a simple matrix type TN, an STN liquid crystal

display device, a ferroelectricity liquid crystal display device, and a polymer dispersed liquid crystal display device.

[0083]

The active matrix type TFT liquid crystal display by a lateral electric field method, in particular, often uses a normally black system, and may easily develop leakage of light due to disarray in liquid crystal molecule orientation around each spacer. Application of this method may effectively prevent occurrence of leakage of light.

10 [0084]

[Effect of the Invention]

In an active matrix type liquid crystal display device according to the present invention and a method for manufacturing the same, as is described above, a first and/or a second projections are provided for preventing spacers from moving in the vicinity of a signal line, a scanning line, or a thin film transistor on a first and/or a second transparent substrate, thereby preventing the spacers moving to a transparent region to reduce leakage of light by the spacer. Thereby the spacers are prevented from moving to the transparent region even when vibration or impact are applied, which reduces leakage of light and improves display quality.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a plan view of the first embodiment of an active matrix type liquid crystal display device of the present invention;

25 Fig. 2 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 1 taken along the line A-A';

Fig. 3 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 1 taken along the line B-B';

Fig. 4 is a plan view of the second embodiment of an active matrix type liquid crystal display device of the present invention;

Fig. 5 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 4 taken along the line C-C';

5 Fig. 6 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 5 taken along the line D-D';

Fig. 7 is a plan view of the third embodiment of an active matrix type liquid crystal display device of the present invention;

Fig. 8 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 7 taken along the line E-E';

Fig. 9 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 8 taken along the line F-F';

Fig. 10 is a plan view of the fourth embodiment of an active matrix type liquid crystal display device of the present invention;

15 Fig. 11 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 10 taken along the line G-G';

Fig. 12 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 11 taken along the line H-H';

Fig. 13 is a plan view of the fifth embodiment of an active matrix type liquid crystal display device of the present invention;

Fig. 14 is a cross-sectional view of the active matrix type liquid crystal display device in Fig. 13 taken along the line I-I';

Fig. 15 is a plan view of a conventional liquid crystal display device of lateral electric field driver-type;

25 Fig. 16 is a cross-sectional view of the lateral electric field driver-type liquid crystal display in Fig. 15. taken along the line J-J';

Fig. 17 is a cross-sectional view of the lateral electric

field driver-type liquid crystal display in Fig. 15. taken along the line K-K';

Fig. 18 is a view showing orientation state of liquid crystal molecules around the spacer in Figs. 16 and 17;

5 Fig. 19 is a view showing orientation state of liquid crystal molecules around the spacer in Figs. 16 and 17;

Fig. 20 is a view showing orientation state of liquid crystal molecules around the spacer in Figs. 16 and 17;

[Description of Notations]

- 10 1 Signal line
- 2 Scanning line
- 3 Thin film transistor
- 4 Common electrode
- 5 Pixel electrode
- 15 6 TFT side projection
- 7 Interlayer insulating film
- 8 Protection/insulation film
- 9 Black matrix
- 10 TFT side glass substrate
- 20 11 Opposite facing glass substrate
- 12 First colored layer
- 13 Second colored layer
- 14 Over-coating film
- 15 TFT side alignment layer
- 25 16 Opposite side alignment layer
- 17 Spacer
- 18 Liquid crystal
- 19 Opposite facing substrate side projection

- 20 Liquid crystal molecule
- 21 Leakage of light
- 22 Interlayer insulating film wall

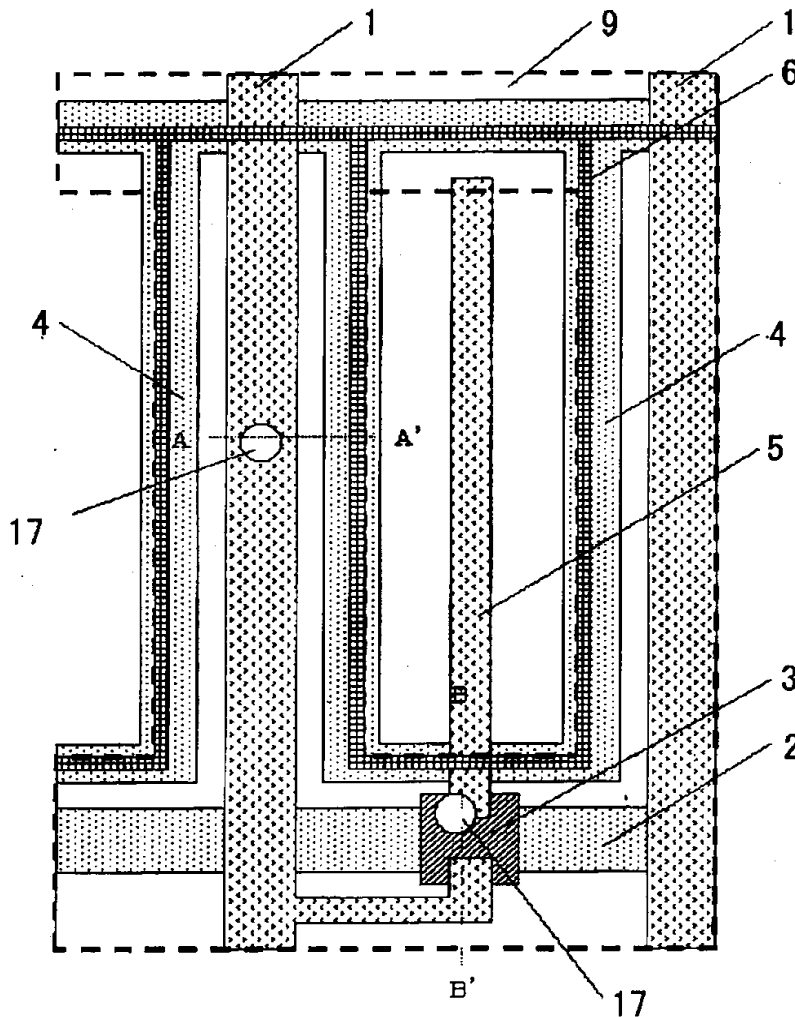
【書類名】 図面

[Document Name]

Drawings

【図1】

Fig. 1



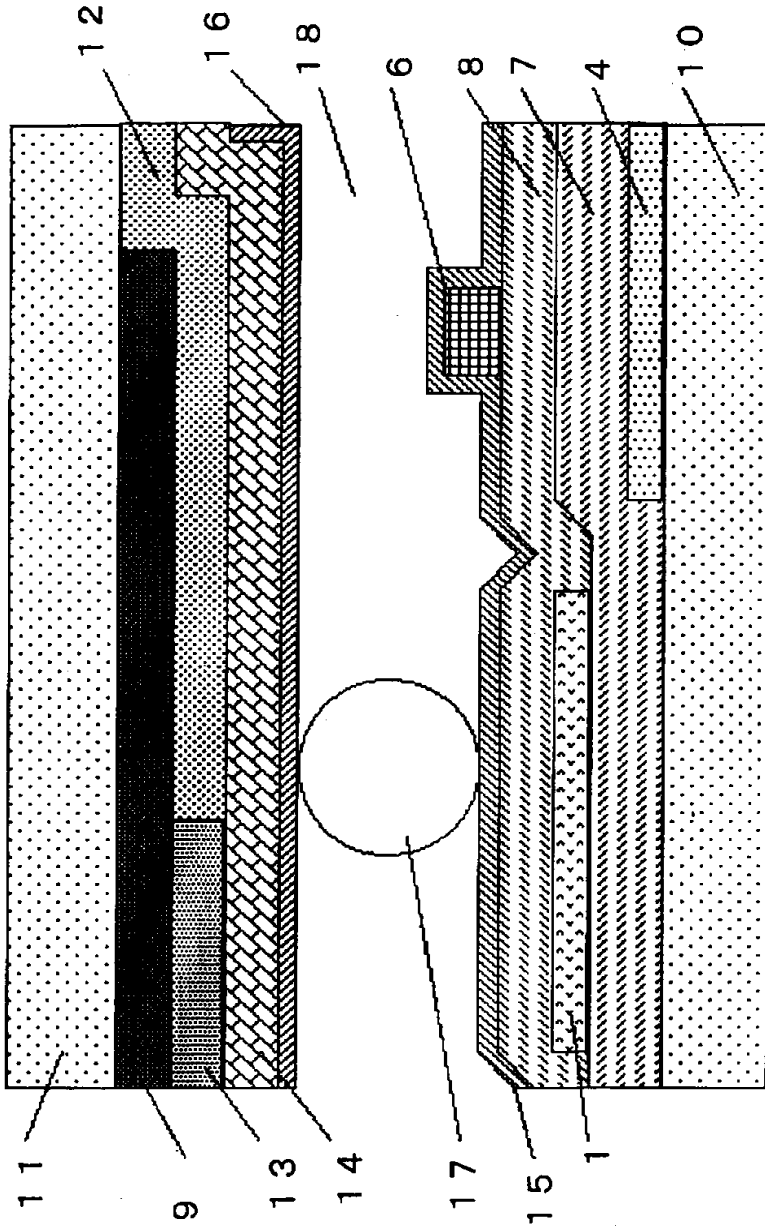
- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 5 画素電極
- 6 TFT側突起部

- 9 ブラックマトリクス
- 17 スペース

- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE
- 5 PIXEL ELECTRODE
- 6 TFT SIDE PROJECTION

- 9 BLACK MATRIX
- 17 SPACER

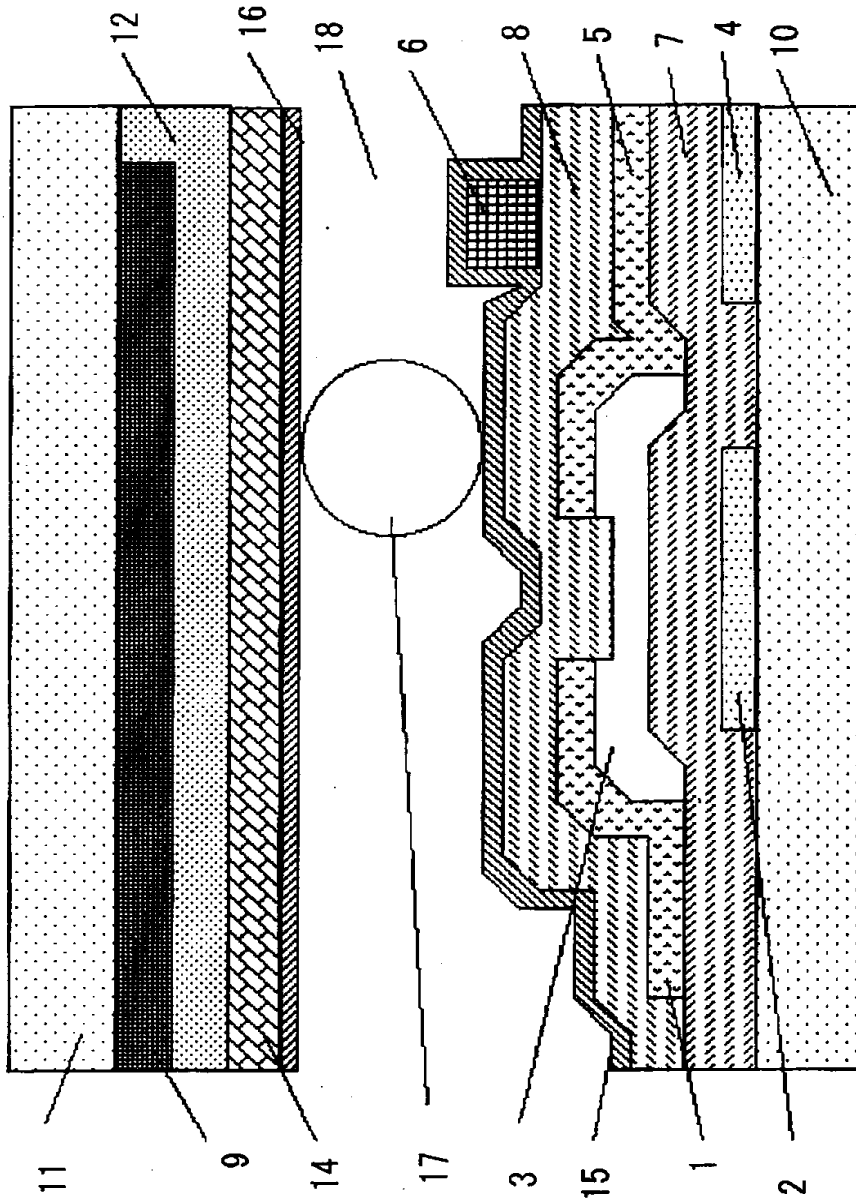
【図2】
Fig. 2



- | | | | | | |
|---|----------------------------|----|---------------------------------|----|-------------------------------|
| 1 | 信号線 | 9 | ブラックマトリクス | 14 | オーバーコート膜 |
| 4 | 共通電極突起部 | 10 | TFT側ガラス基板 | 15 | TFT側配向膜 |
| 6 | TFT側絶縁膜 | 11 | 対向側ガラス基板 | 16 | 対向側配向膜 |
| 7 | 層間絶縁膜 | 12 | 第1の色層 | 17 | スペーサ |
| 8 | 保護絶縁膜 | 13 | 第2の色層 | 18 | 液晶 |
| 1 | SIGNAL LINE | 9 | BLACK MATRIX | 14 | OVER-COATING FILM |
| 4 | COMMON ELECTRODE | 10 | TFT SIDE GLASS SUBSTRATE | 15 | TFT SIDE ALIGNMENT LAYER |
| 6 | TFT SIDE PROTECTION | 11 | OPPOSITE FACING GLASS SUBSTRATE | 16 | OPPOSITE SIDE ALIGNMENT LAYER |
| 7 | INTERLAYER INSULATING FILM | 12 | FIRST COLORED LAYER | 17 | SPACER |
| 8 | PROTECTION/INSULATION FILM | 13 | SECOND COLORED LAYER | 18 | LIQUID CRYSTAL |

【図3】

Fig. 3



15 TFT側配向膜
16 対向側配向膜
17 スペース
18 液晶

15 保護絶縁膜
16 ブラックマトリクス
17 TFT側ガラス基板
18 対向側ガラス基板

10 第1の色層
11 オーパーコート膜
12 PROTECTION/INSULATION FILM
13 BLACK MATRIX

14 TFT SIDE GLASS SUBSTRATE
15 OPPOSITE FACING GLASS SUBSTRATE
16 FIRST COLORED LAYER
17 OVER-COATING FILM

1 SIGNAL LINE
2 SCANNING LINE
3 THIN FILM TRANSISTOR
4 COMMON ELECTRODE
5 PIXEL ELECTRODE
6 TFT SIDE PROJECTION

1 信号線
2 走査線
3 薄膜トランジスタ
4 共通電極
5 画素電極
6 TFT側突起部

15 保護絶縁膜
16 ブラックマトリクス
17 TFT側ガラス基板
18 対向側ガラス基板

10 第1の色層
11 オーパーコート膜
12 PROTECTION/INSULATION FILM
13 BLACK MATRIX

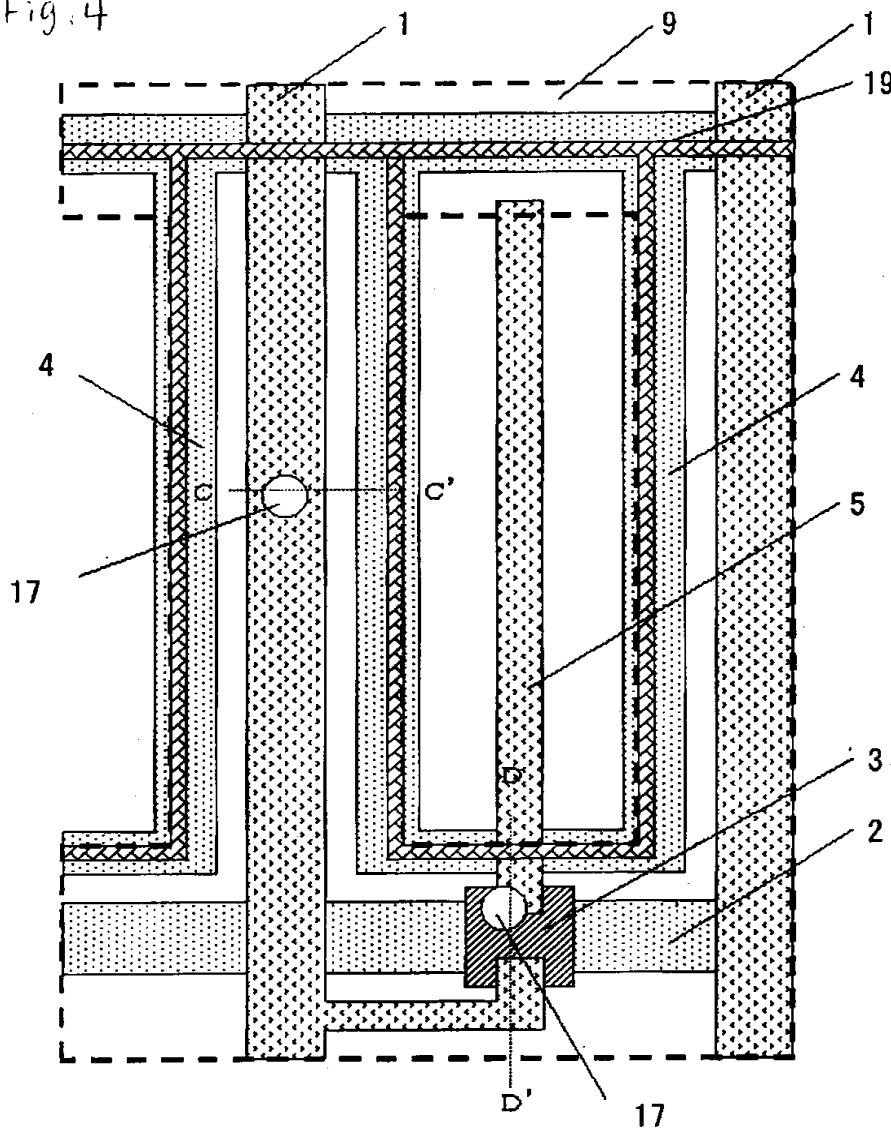
14 TFT SIDE GLASS SUBSTRATE
15 OPPOSITE FACING GLASS SUBSTRATE
16 FIRST COLORED LAYER
17 OVER-COATING FILM

1 SIGNAL LINE
2 SCANNING LINE
3 THIN FILM TRANSISTOR
4 COMMON ELECTRODE
5 PIXEL ELECTRODE
6 TFT SIDE PROJECTION

1 信号線
2 走査線
3 薄膜トランジスタ
4 共通電極
5 画素電極
6 TFT側突起部

【図4】

Fig. 4



- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 5 画素電極

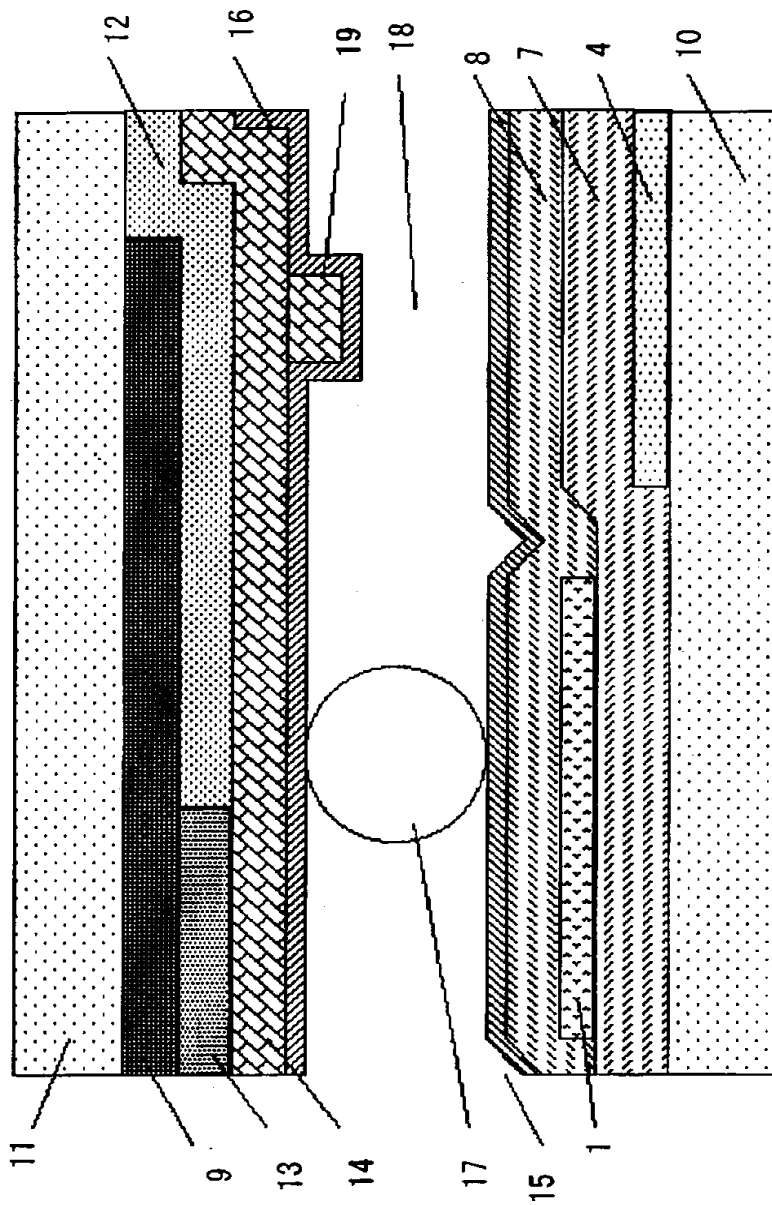
- 9 ブラックマトリクス
- 17 スペース
- 19 対向基板側突起部

- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE
- 5 PIXEL ELECTRODE

- 9 BLACK MATRIX
- 17 SPACER
- 19 OPPOSITE FACING SUBSTRATE
SIDE PROJECTION

【図5】

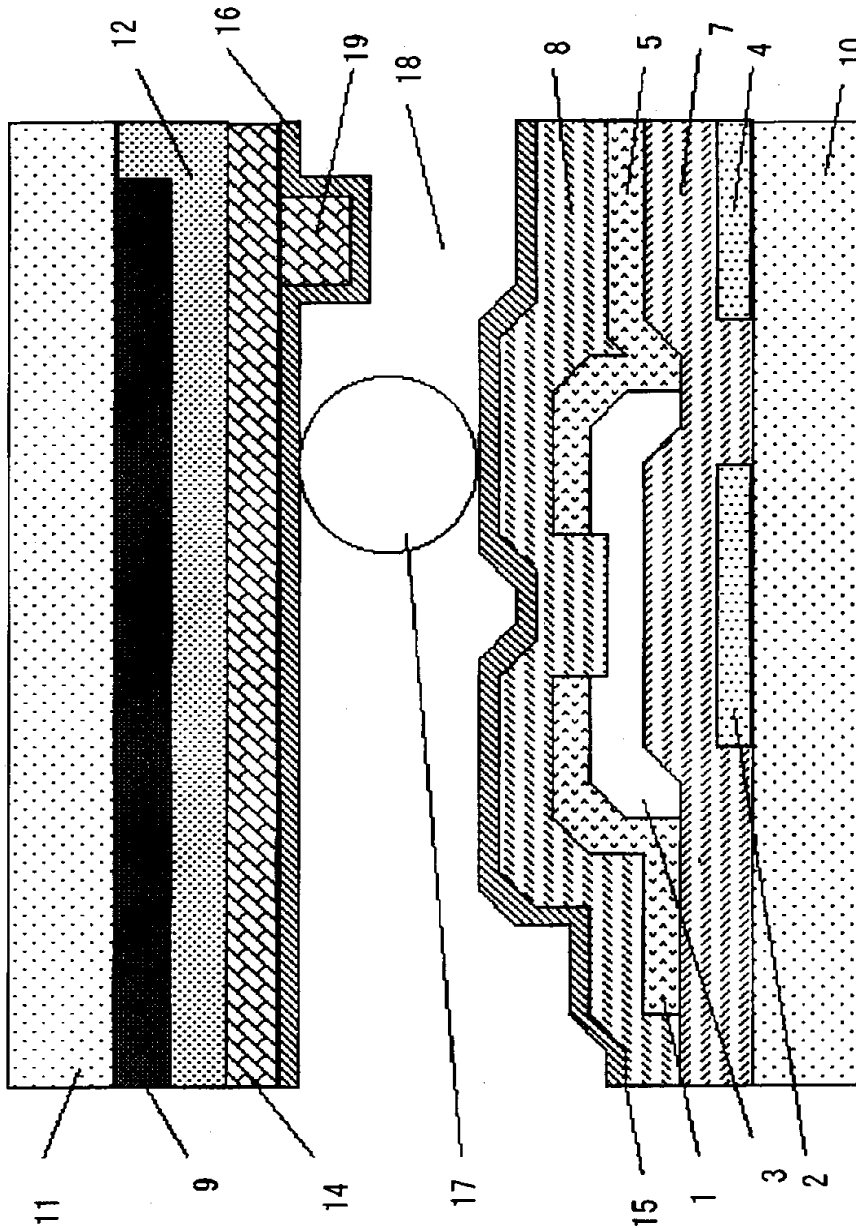
Fig. 5



- | | | | | | |
|---|----------------------------|----|---------------------------------|----|---|
| 1 | 信号線 | 10 | TFT側ガラス基板 | 15 | TFT側配向膜 |
| 4 | 共通電極 | 11 | 対向側ガラス基板 | 16 | 対向側配向膜 |
| 7 | 層間絶縁膜 | 12 | 第1の色層 | 17 | スペーサ |
| 8 | 保護絶縁膜 | 13 | 第2の色層 | 18 | 液晶 |
| 9 | ブラックマトリクス | 14 | オーバーコート膜 | 19 | 対向基板側突起部 |
| 1 | SIGNAL LINE | 10 | TFT SIDE GLASS SUBSTRATE | 15 | TFT SIDE ALIGNMENT LAYER |
| 4 | COMMON ELECTRODE | 11 | OPPOSITE FACING GLASS SUBSTRATE | 16 | OPPOSITE SIDE ALIGNMENT LAYER |
| 7 | INTERLAYER INSULATING FILM | 12 | FIRST COLORED LAYER | 17 | SPACER |
| 8 | PROTECTION/INSULATION FILM | 13 | SECOND COLORED LAYER | 18 | LIQUID CRYSTAL |
| 9 | BLACK MATRIX | 14 | OVER-COATING FILM | 19 | OPPOSITE FACING SUBSTRATE SIDE PROJECTION |

【図6】

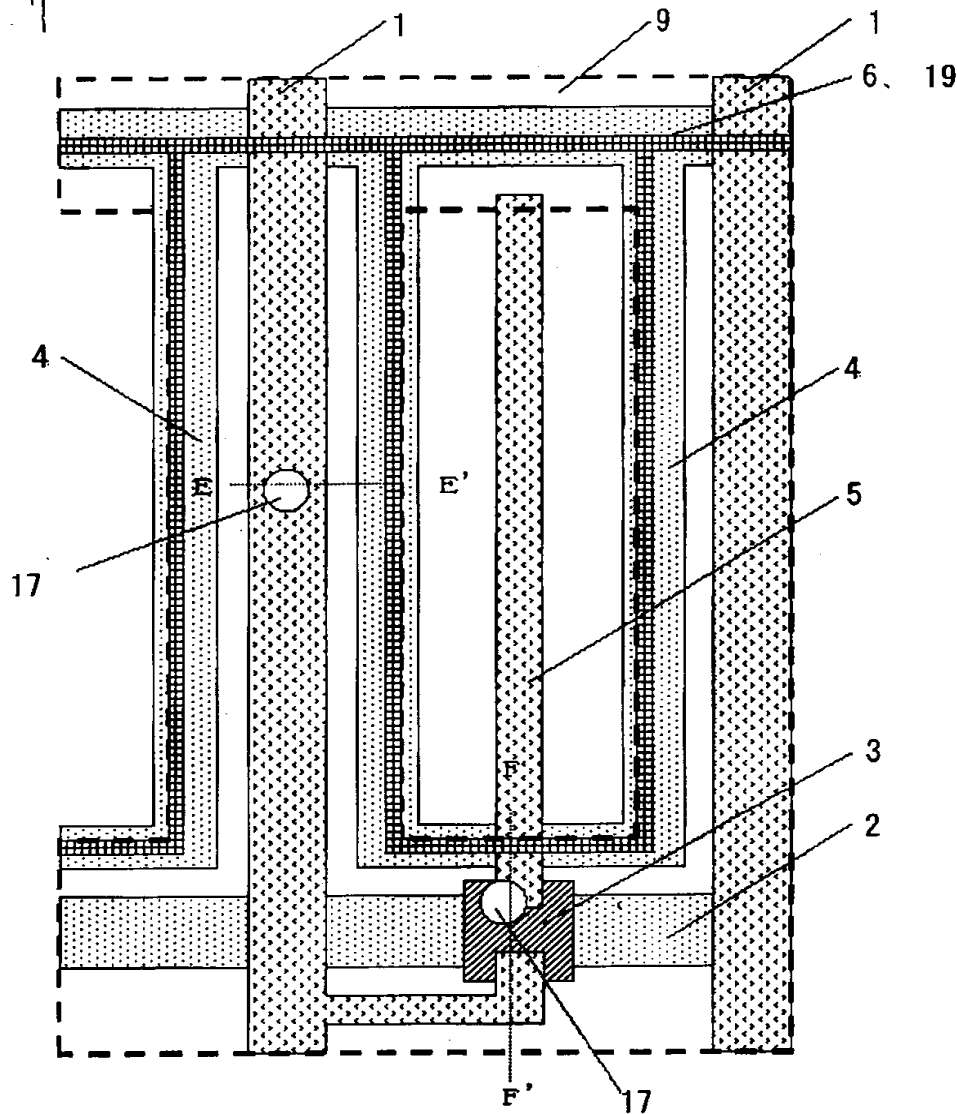
Fig. 6



- | | | | |
|----|----------------------------------|----|----------|
| 1 | 信号線 | 15 | TFT側配向膜 |
| 2 | 走査線 | 16 | 対向側配向膜 |
| 3 | 薄膜トランジスタ | 17 | スペーサ |
| 4 | 共通電極 | 18 | 液晶 |
| 5 | 画素電極 | 19 | 対向基板側突起部 |
| 7 | 層間絶縁膜 | | |
| 8 | 保護絶縁膜 | | |
| 9 | ブラックマトリクス | | |
| 10 | ガラス基板 | | |
| 11 | TFT側ガラス基板 | | |
| 12 | 対向側ガラス基板 | | |
| 14 | 第1の色層 | | |
| 15 | オーバーコート膜 | | |
| 16 | PROTECTION/INSULATION FILM | | |
| 17 | BLACK MATRIX | | |
| 18 | TFT SIDE GLASS SUBSTRATE | | |
| 19 | OPPOSITE FACING GLASS SUBSTRATE | | |
| | FIRST COLORED LAYER | | |
| | OVER-COATING FILM | | |
| | SIGNAL LINE | | |
| | SCANNING LINE | | |
| | THIN FILM TRANSISTOR | | |
| | COMMON ELECTRODE | | |
| | PIXEL ELECTRODE | | |
| | INTERLAYER INSULATING FILM | | |
| | 15 TFT SIDE ALIGNMENT LAYER | | |
| | 16 OPPOSITE SIDE ALIGNMENT LAYER | | |
| | 17 SPACER | | |
| | 18 LIQUID CRYSTAL | | |
| | 19 OPPOSITE FACING SUBSTRATE | | |
| | SIDE PROJECTION | | |

【図7】

Fig. 7



- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 5 画素電極

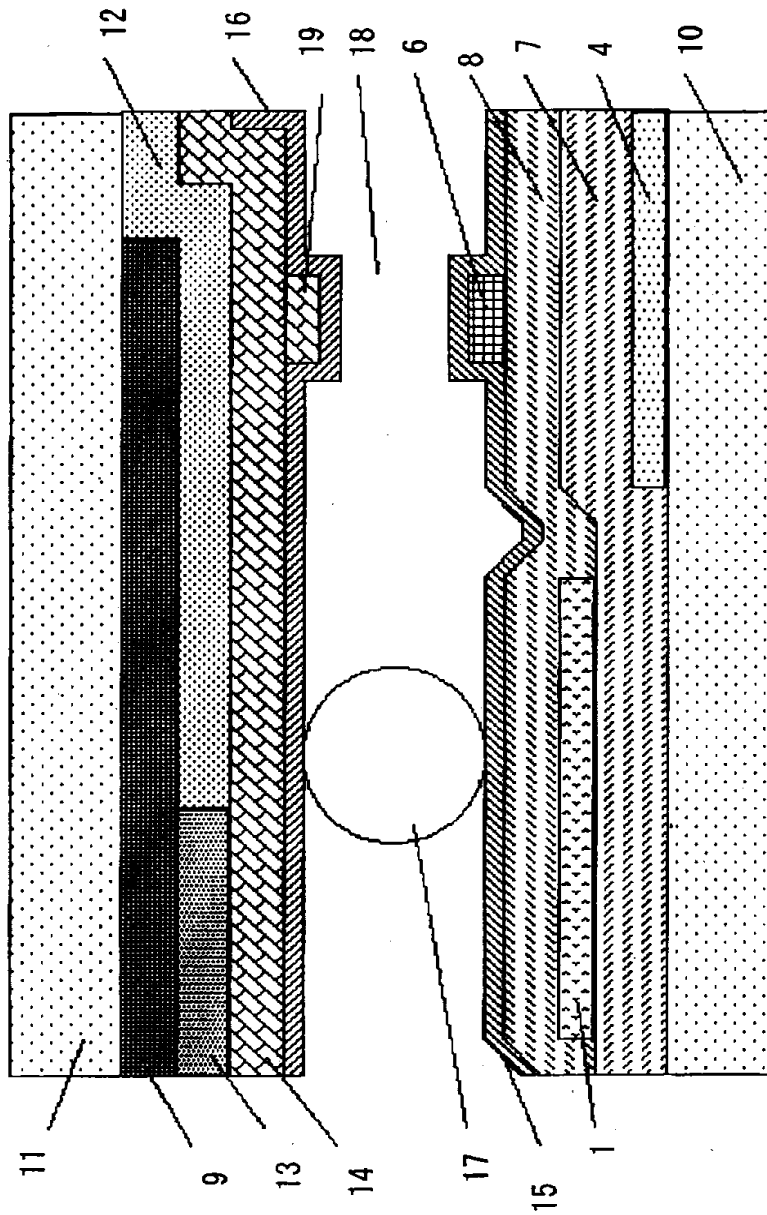
- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE
- 5 PIXEL ELECTRODE

- 6 TFT側突起部
- 17 スペース
- 19 対向基板側突起部

- 6 TFT SIDE PROJECTION
- 17 SPACER
- 19 OPPOSITE FACING SUBSTRATE
SIDE PROJECTION

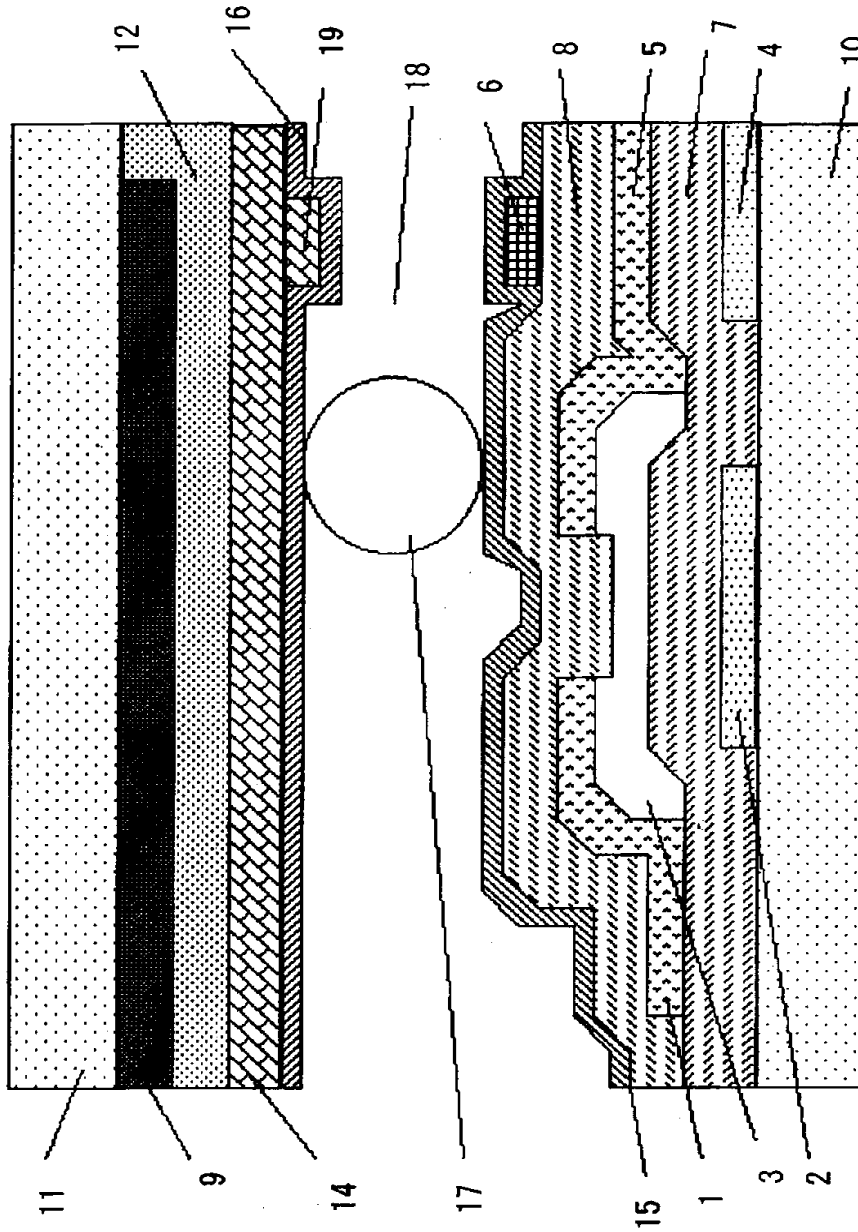
【図8】

Fig. 6



- | | | | | | |
|---|----------------------------|----|---------------------------------|----|---|
| 1 | 信号線 | 10 | TFT 側ガラス基板 | 15 | TFT 側配向膜 |
| 4 | 共通電極 | 11 | 対向側ガラス基板 | 16 | 対向側配向膜 |
| 7 | 層間絶縁膜 | 12 | 第1の色層 | 17 | スペーサ |
| 8 | 保護絶縁膜 | 13 | 第2の色層 | 18 | 液晶 |
| 9 | ブラックマトリクス | 14 | オーバーコート膜 | 19 | 対向基板側突起部 |
| 1 | SIGNAL LINE | 10 | TFT SIDE GLASS SUBSTRATE | 15 | TFT SIDE ALIGNMENT LAYER |
| 4 | COMMON ELECTRODE | 11 | OPPOSITE FACING GLASS SUBSTRATE | 16 | OPPOSITE SIDE ALIGNMENT LAYER |
| 7 | INTERLAYER INSULATING FILM | 12 | FIRST COLORED LAYER | 17 | SPACER |
| 8 | PROTECTION/INSULATION FILM | 13 | SECOND COLORED LAYER | 18 | LIQUID CRYSTAL |
| 9 | BLACK MATRIX | 14 | OVER-COATING FILM | 19 | OPPOSITE FACING SUBSTRATE SIDE PROJECTION |

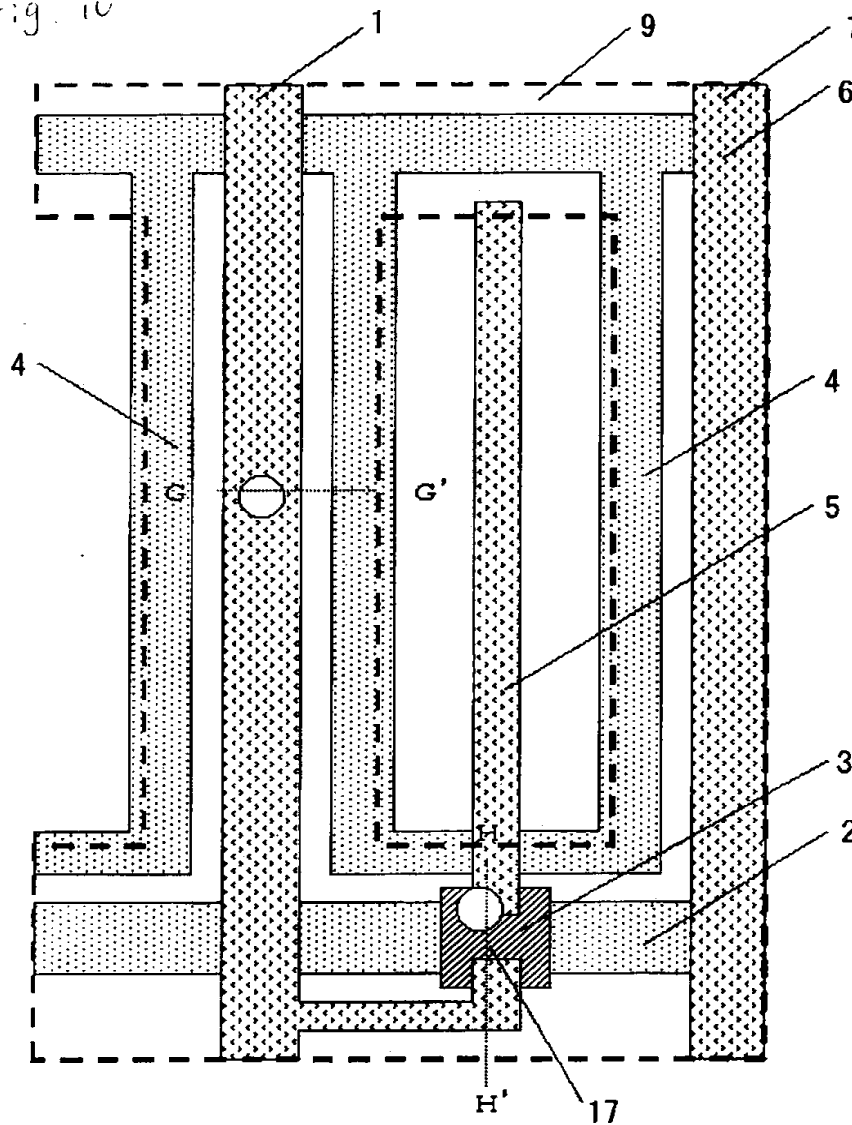
【図9】
Fig. 9



- | | | | | | |
|---|------------------------|----|---------------------------------|----|---|
| 1 | 信号線 | 11 | 対向側ガラス基板 | 17 | スペーサ |
| 2 | 走査線 | 12 | 第1の色層 | 18 | 液晶 |
| 3 | 薄膜トランジスタ | 14 | オーバーコート膜 | 19 | 対向基板側突起部 |
| 4 | 共通電極 | 15 | TFT側配向膜 | | |
| 5 | 画素電極 | 16 | 対向側配向膜 | | |
| | 1 SIGNAL LINE | | | | |
| | 2 SCANNING LINE | 11 | OPPOSITE FACING GLASS SUBSTRATE | 17 | SPACER |
| | 3 THIN FILM TRANSISTOR | 12 | FIRST COLORED LAYER | 18 | LIQUID CRYSTAL |
| | 4 COMMON ELECTRODE | 14 | OVER-COATING FILM | 19 | OPPOSITE FACING SUBSTRATE SIDE PROJECTION |
| | 5 PIXEL ELECTRODE | 15 | TFT SIDE ALIGNMENT LAYER | | |
| | | 16 | OPPOSITE SIDE ALIGNMENT LAYER | | |
| | | | | | |

【図10】

Fig. 10

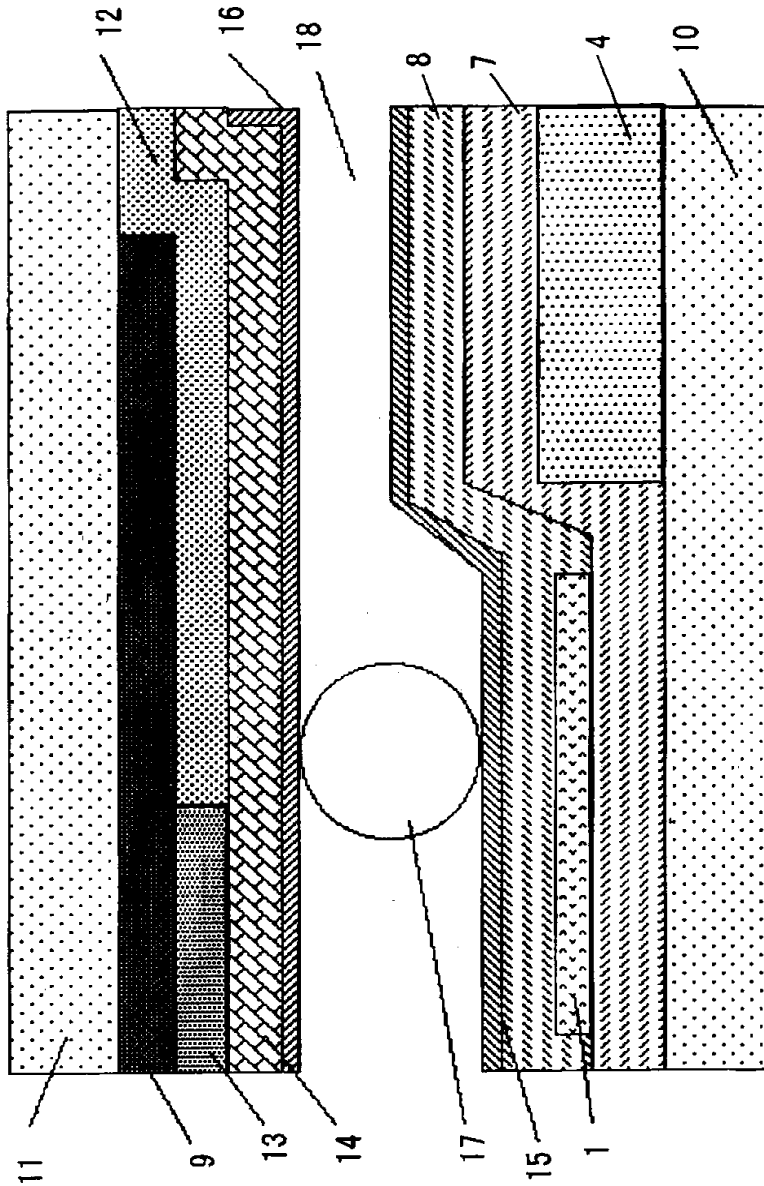


- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE

- 5 画素電極
- 6 TFT側突起部
- 9 ブラックマトリクス
- 17 スペース
- 5 PIXEL ELECTRODE
- 6 TFT SIDE PROJECTION
- 9 BLACK MATRIX
- 17 SPACER

【図11】

Fig. 11

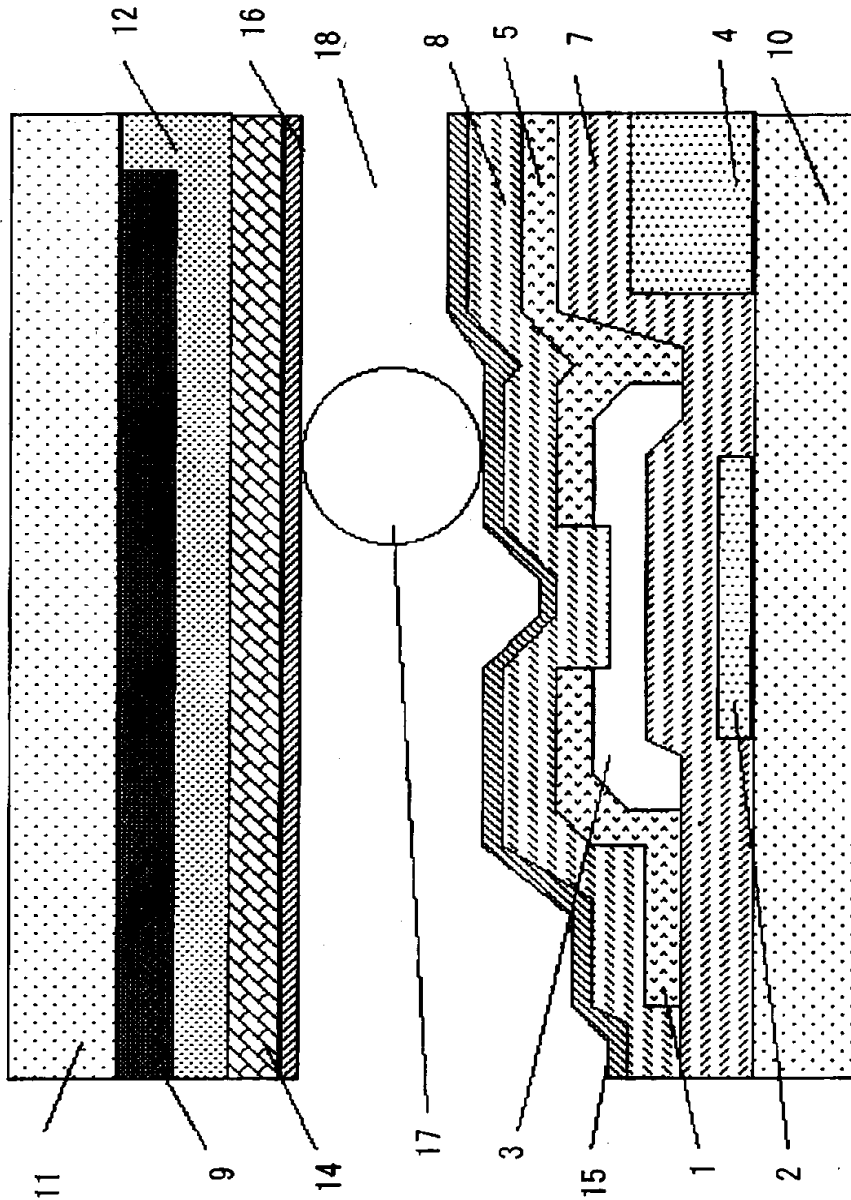


1 1 対向側ガラス基板
1 2 第1の色層
1 3 第2の色層
1 4 オーバコート膜
1 5 TFT側配向膜
1 6 対向側配向膜

1 信号線
4 共通電極
7 層間絶縁膜
8 保護絶縁膜
9 ブラックマトリクス
10 TFT側ガラス基板

11 OPPOSITE FACING GLASS SUBSTRATE
12 FIRST COLORED LAYER
13 SECOND COLORED LAYER
14 OVER-COATING FILM
15 TFT SIDE ALIGNMENT LAYER
16 OPPOSITE SIDE ALIGNMENT LAYER
17 SPACER
18 LIQUID CRYSTAL

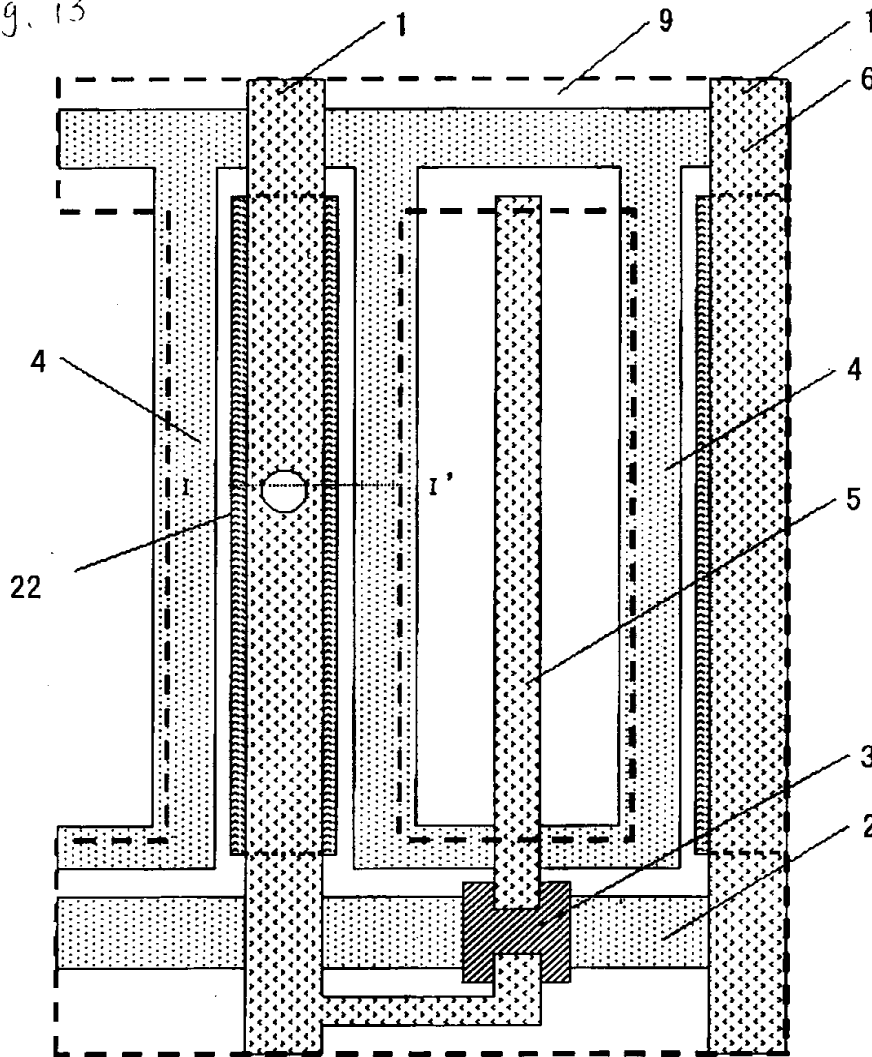
【図12】
Fig. 12



- | | | | | | |
|---|----------------------------|----|---------------------------------|----|-------------------------------|
| 1 | 信号線 | 8 | 保護絶縁膜 | 14 | オーバーコート膜 |
| 2 | 走査線 | 9 | ブラックマトリクス | 15 | TFT側配向膜 |
| 3 | 薄膜トランジスタ | 10 | TFT側ガラス基板 | 16 | 対向側配向膜 |
| 4 | 共通電極 | 11 | TFT側ガラス基板 | 17 | スペーサ |
| 5 | 画素電極 | 12 | 対向側ガラス基板 | 18 | 液晶 |
| 7 | 層間絶縁膜 | 13 | 第1の色層 | | |
| | | | 第2の色層 | | |
| 1 | SIGNAL LINE | 8 | PROTECTION/INSULATION FILM | 14 | OVER-COATING FILM |
| 2 | SCANNING LINE | 9 | BLACK MATRIX | 15 | TFT SIDE ALIGNMENT LAYER |
| 3 | THIN FILM TRANSISTOR | 10 | TFT SIDE GLASS SUBSTRATE | 16 | OPPOSITE SIDE ALIGNMENT LAYER |
| 4 | COMMON ELECTRODE | 11 | OPPOSITE FACING GLASS SUBSTRATE | 17 | SPACER |
| 5 | PIXEL ELECTRODE | 12 | FIRST COLORED LAYER | 18 | LIQUID CRYSTAL |
| 7 | INTERLAYER INSULATING FILM | 13 | SECOND COLORED LAYER | | |

【図13】

Fig. 13



- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 5 画素電極

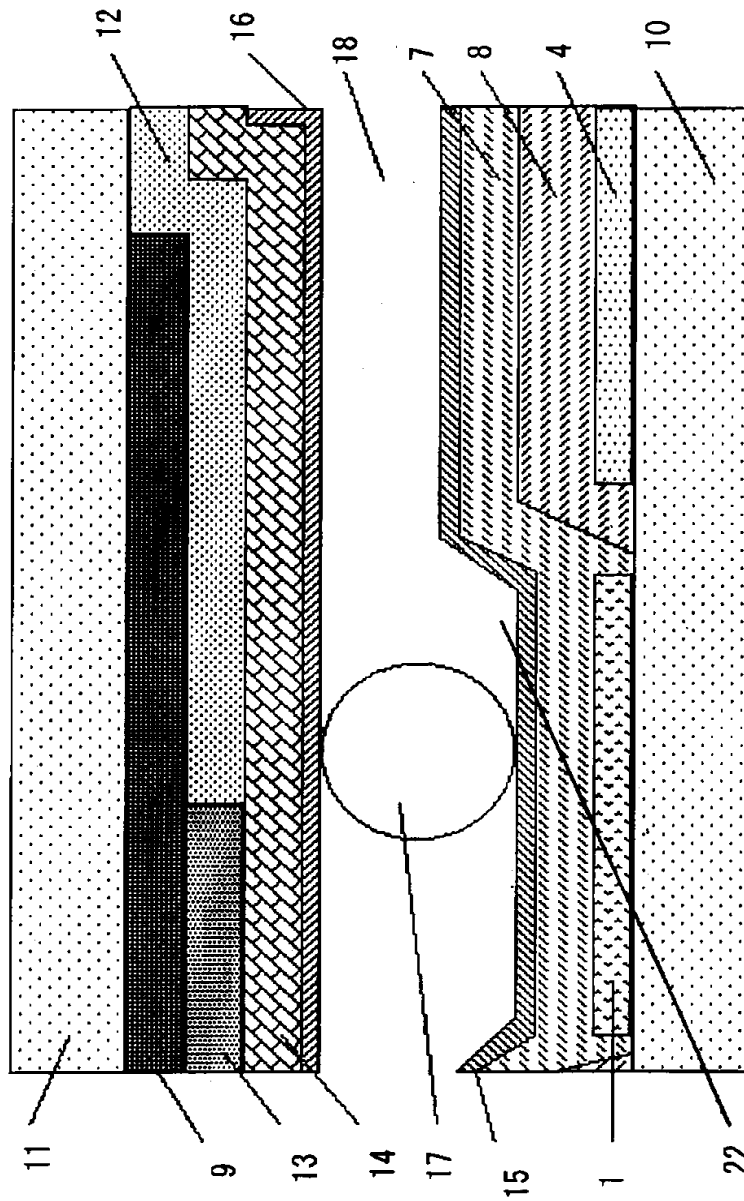
- 6 TFT側突起部
- 9 ブラックマトリクス
- 22 層間絶縁膜段差

- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE
- 5 PIXEL ELECTRODE

- 6 TFT SIDE PROJECTION
- 9 BLACK MATRIX
- 22 INTERLAYER INSULATING FILM WALL

【図14】

Fig. 14



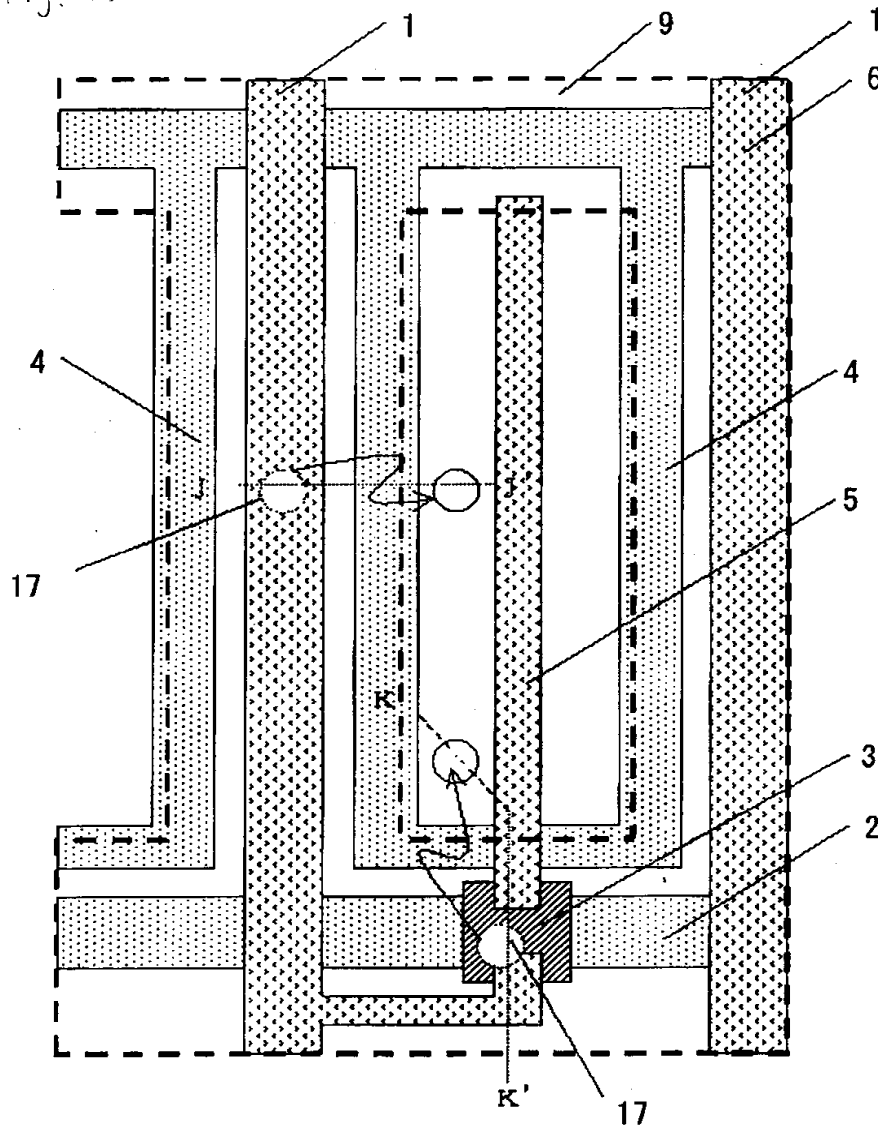
1 信号線
4 共通電極
7 層間絶縁膜
8 保護絶縁膜
9 ブラックマトリクス
10 TFT側ガラス基板
11 SIGNAL LINE
4 COMMON ELECTRODE
7 INTERLAYER INSULATING FILM
8 PROTECTION/INSULATION FILM
9 BLACK MATRIX
10 TFT SIDE GLASS SUBSTRATE

11 対向側ガラス基板
12 第1の色層
13 第2の色層
14 オーバコート膜
15 TFT側配向膜
16 対向側配向膜
17 OPPOSITE FACING GLASS SUBSTRATE
12 FIRST COLORED LAYER
13 SECOND COLORED LAYER
14 OVER-COATING FILM
15 TFT SIDE ALIGNMENT LAYER
16 OPPOSITE SIDE ALIGNMENT LAYER

17 スペース
18 液晶
22 層間絶縁膜段差
17 SPACER
18 LIQUID CRYSTAL
22 INTERLAYER INSULATING FILM WALL

【図15】

Fig. 15

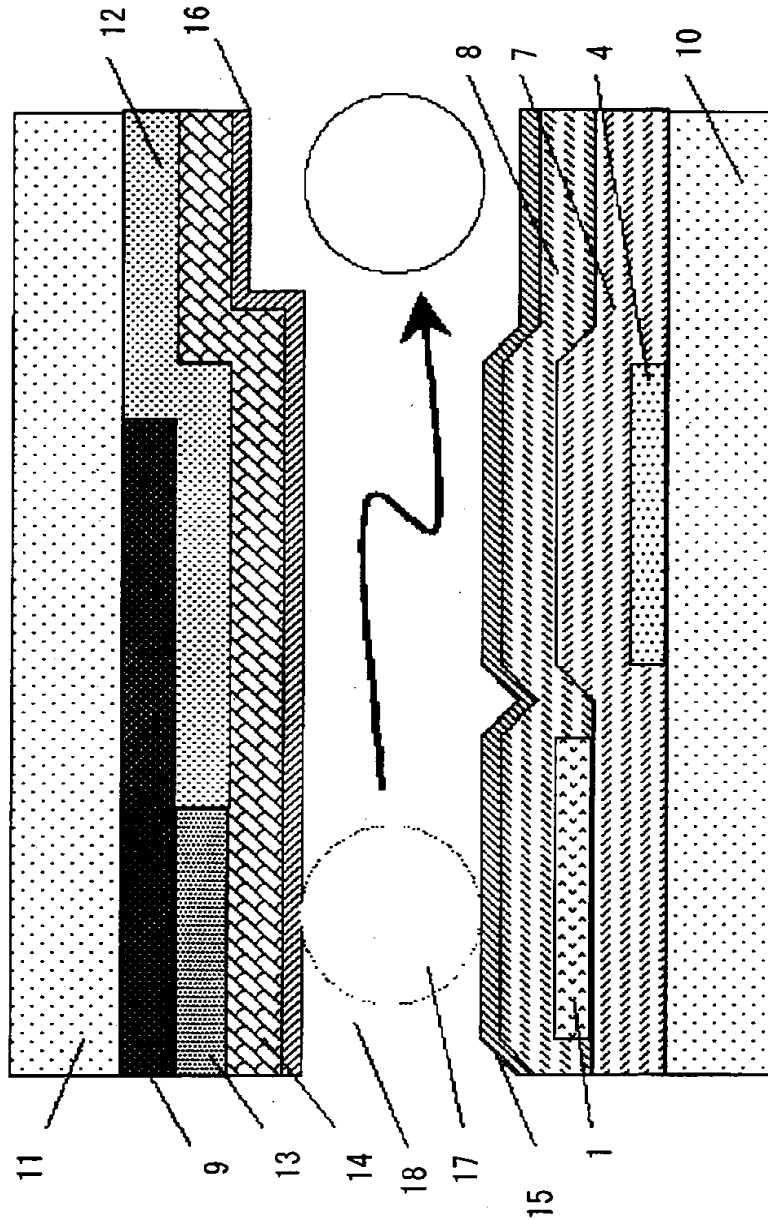


- 1 信号線
- 2 走査線
- 3 薄膜トランジスタ
- 4 共通電極
- 1 SIGNAL LINE
- 2 SCANNING LINE
- 3 THIN FILM TRANSISTOR
- 4 COMMON ELECTRODE

- 5 画素電極
- 6 TFT側突起部
- 9 ブラックマトリクス
- 17 スペース
- 5 PIXEL ELECTRODE
- 6 TFT SIDE PROJECTION
- 9 BLACK MATRIX
- 17 SPACER

【図16】

Fig. 16



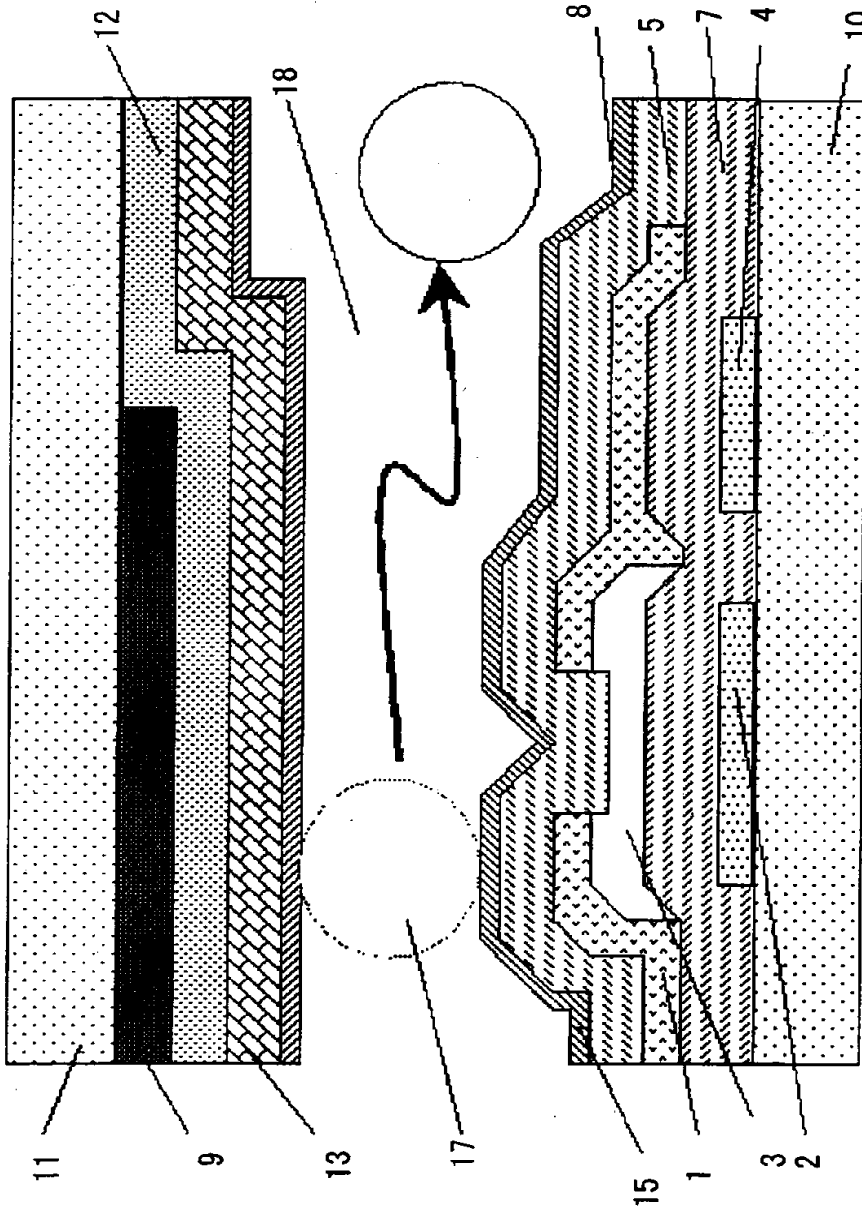
1 信号線
4 共通電極
7 層間絶縁膜
8 保護絶縁膜
9 ブラックマトリクス
10 TFT側ガラス基板
11 対向側ガラス基板
12 第1の色層
13 第2の色層
14 オートバコート膜
15 TFT側配向膜
16 対向側配向膜
17 スペース
18 液晶

12 FIRST COLORED LAYER
13 SECOND COLORED LAYER
14 OVER-COATING FILM
15 TFT SIDE ALIGNMENT LAYER
16 OPPOSITE SIDE ALIGNMENT LAYER
17 SPACER
18 LIQUID CRYSTAL

1 SIGNAL LINE
4 COMMON ELECTRODE
7 INTERLAYER INSULATING FILM
8 PROTECTION/INSULATION FILM
9 BLACK MATRIX
10 TFT SIDE GLASS SUBSTRATE
11 OPPOSITE FACING GLASS SUBSTRATE

【図17】

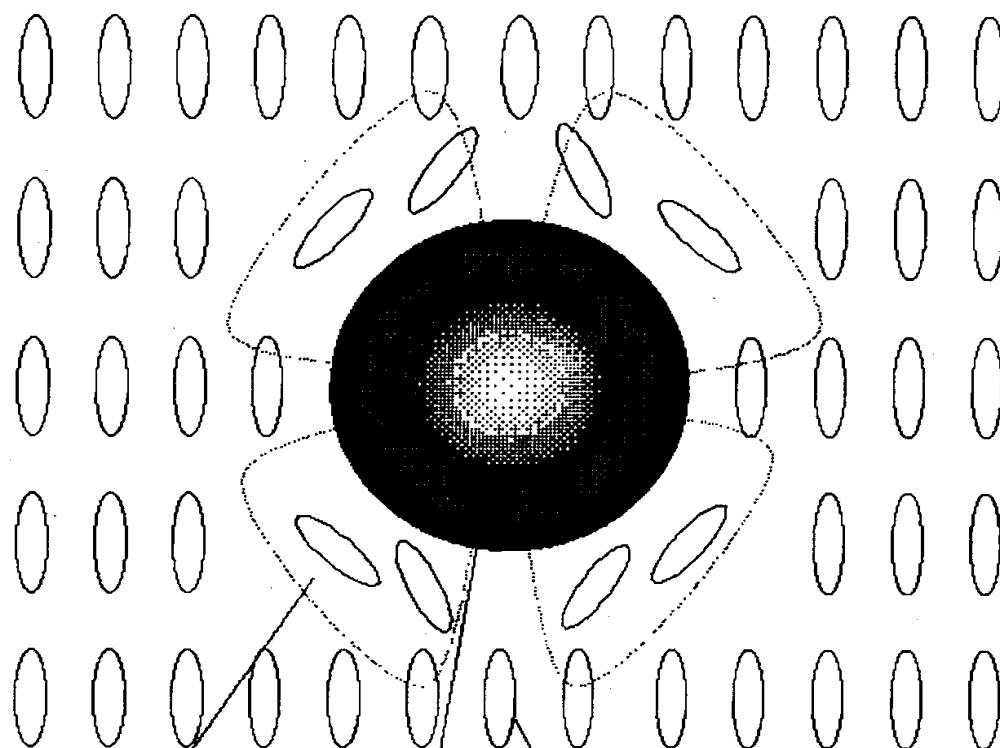
Fig. 17



- | | | | |
|-----|---------------------------------|----|---------|
| 1 | 信号線 | 1 | 第1の色層 |
| 2 | 走査線 | 2 | TFT側配向膜 |
| 3 | 薄膜トランジスタ | 15 | TFT側配向膜 |
| 4 | 共通電極 | 17 | スペーサ |
| 5 | 画素電極 | 18 | 液晶 |
| 7 | 層間絶縁膜 | | |
| 8 | 保護絶縁膜 | | |
| 9 | ブラックマトリクス | | |
| 10 | TFT側ガラス基板 | | |
| 11 | 対向側ガラス基板 | | |
| 12 | INTERLAYER INSULATING FILM | | |
| 13 | PROTECTION/INSULATION FILM | | |
| 14 | BLACK MATRIX | | |
| 15 | TFT SIDE GLASS SUBSTRATE | | |
| 16 | OPPOSITE FACING GLASS SUBSTRATE | | |
| 17 | 第1の色層 | | |
| 18 | TFT側配向膜 | | |
| 19 | スペーサ | | |
| 20 | 液晶 | | |
| 21 | 第1の色層 | | |
| 22 | TFT側配向膜 | | |
| 23 | スペーサ | | |
| 24 | 液晶 | | |
| 25 | 第1の色層 | | |
| 26 | TFT側配向膜 | | |
| 27 | スペーサ | | |
| 28 | 液晶 | | |
| 29 | 第1の色層 | | |
| 30 | TFT側配向膜 | | |
| 31 | スペーサ | | |
| 32 | 液晶 | | |
| 33 | 第1の色層 | | |
| 34 | TFT側配向膜 | | |
| 35 | スペーサ | | |
| 36 | 液晶 | | |
| 37 | 第1の色層 | | |
| 38 | TFT側配向膜 | | |
| 39 | スペーサ | | |
| 40 | 液晶 | | |
| 41 | 第1の色層 | | |
| 42 | TFT側配向膜 | | |
| 43 | スペーサ | | |
| 44 | 液晶 | | |
| 45 | 第1の色層 | | |
| 46 | TFT側配向膜 | | |
| 47 | スペーサ | | |
| 48 | 液晶 | | |
| 49 | 第1の色層 | | |
| 50 | TFT側配向膜 | | |
| 51 | スペーサ | | |
| 52 | 液晶 | | |
| 53 | 第1の色層 | | |
| 54 | TFT側配向膜 | | |
| 55 | スペーサ | | |
| 56 | 液晶 | | |
| 57 | 第1の色層 | | |
| 58 | TFT側配向膜 | | |
| 59 | スペーサ | | |
| 60 | 液晶 | | |
| 61 | 第1の色層 | | |
| 62 | TFT側配向膜 | | |
| 63 | スペーサ | | |
| 64 | 液晶 | | |
| 65 | 第1の色層 | | |
| 66 | TFT側配向膜 | | |
| 67 | スペーサ | | |
| 68 | 液晶 | | |
| 69 | 第1の色層 | | |
| 70 | TFT側配向膜 | | |
| 71 | スペーサ | | |
| 72 | 液晶 | | |
| 73 | 第1の色層 | | |
| 74 | TFT側配向膜 | | |
| 75 | スペーサ | | |
| 76 | 液晶 | | |
| 77 | 第1の色層 | | |
| 78 | TFT側配向膜 | | |
| 79 | スペーサ | | |
| 80 | 液晶 | | |
| 81 | 第1の色層 | | |
| 82 | TFT側配向膜 | | |
| 83 | スペーサ | | |
| 84 | 液晶 | | |
| 85 | 第1の色層 | | |
| 86 | TFT側配向膜 | | |
| 87 | スペーサ | | |
| 88 | 液晶 | | |
| 89 | 第1の色層 | | |
| 90 | TFT側配向膜 | | |
| 91 | スペーサ | | |
| 92 | 液晶 | | |
| 93 | 第1の色層 | | |
| 94 | TFT側配向膜 | | |
| 95 | スペーサ | | |
| 96 | 液晶 | | |
| 97 | 第1の色層 | | |
| 98 | TFT側配向膜 | | |
| 99 | スペーサ | | |
| 100 | 液晶 | | |

【図18】

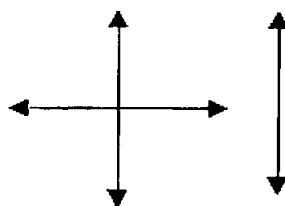
Fig. 18



21

17

20



吸収軸 ラビング方向

ABSORPTION AXIS

THE DIRECTION OF RUBBING

17 スペース 20 液晶分子 21 光漏れ

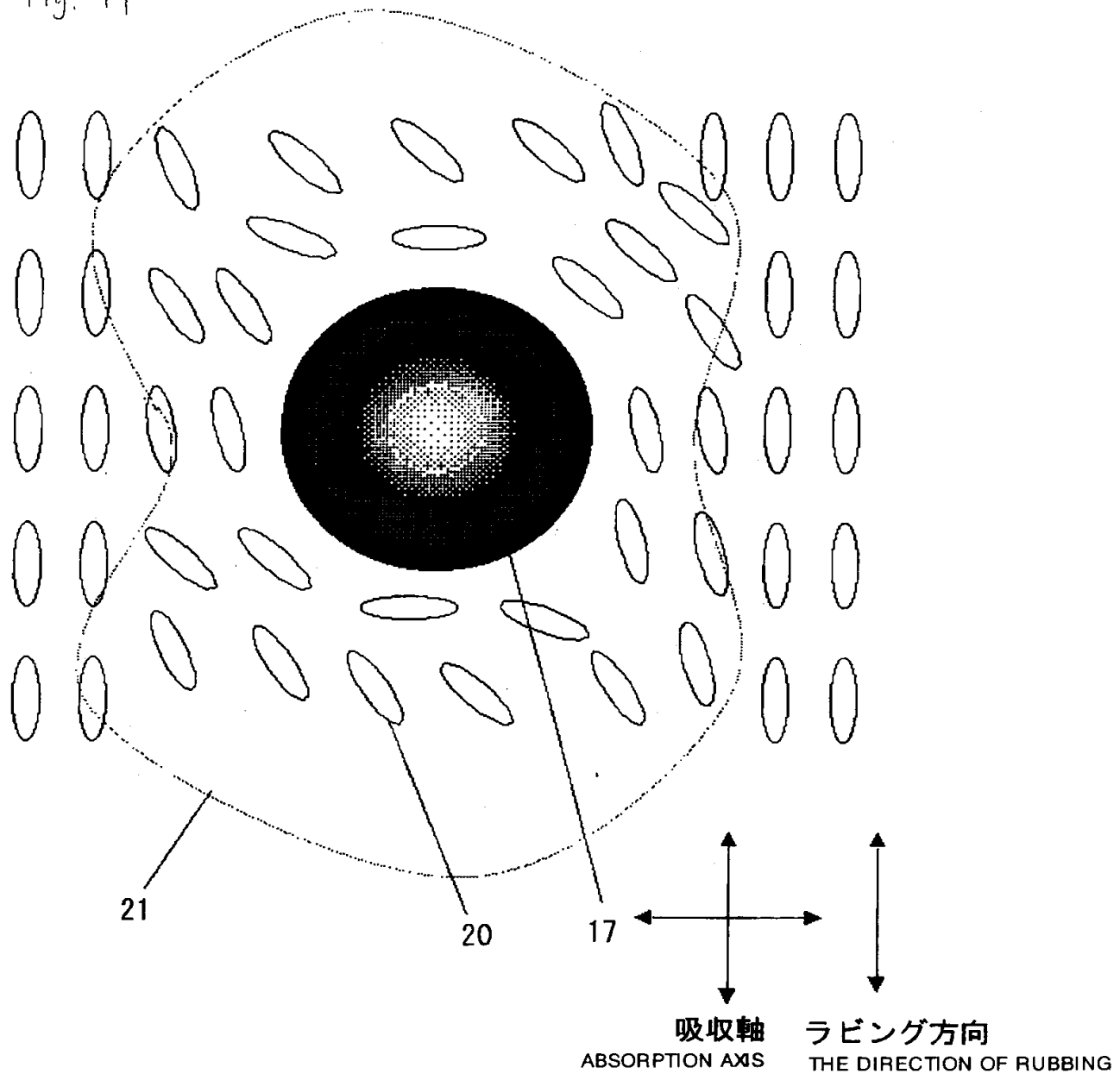
17 SPACER

20 LIQUID CRYSTAL MOLECULE

21 LEAKAGE OF LIGHT

【図19】

Fig. 19

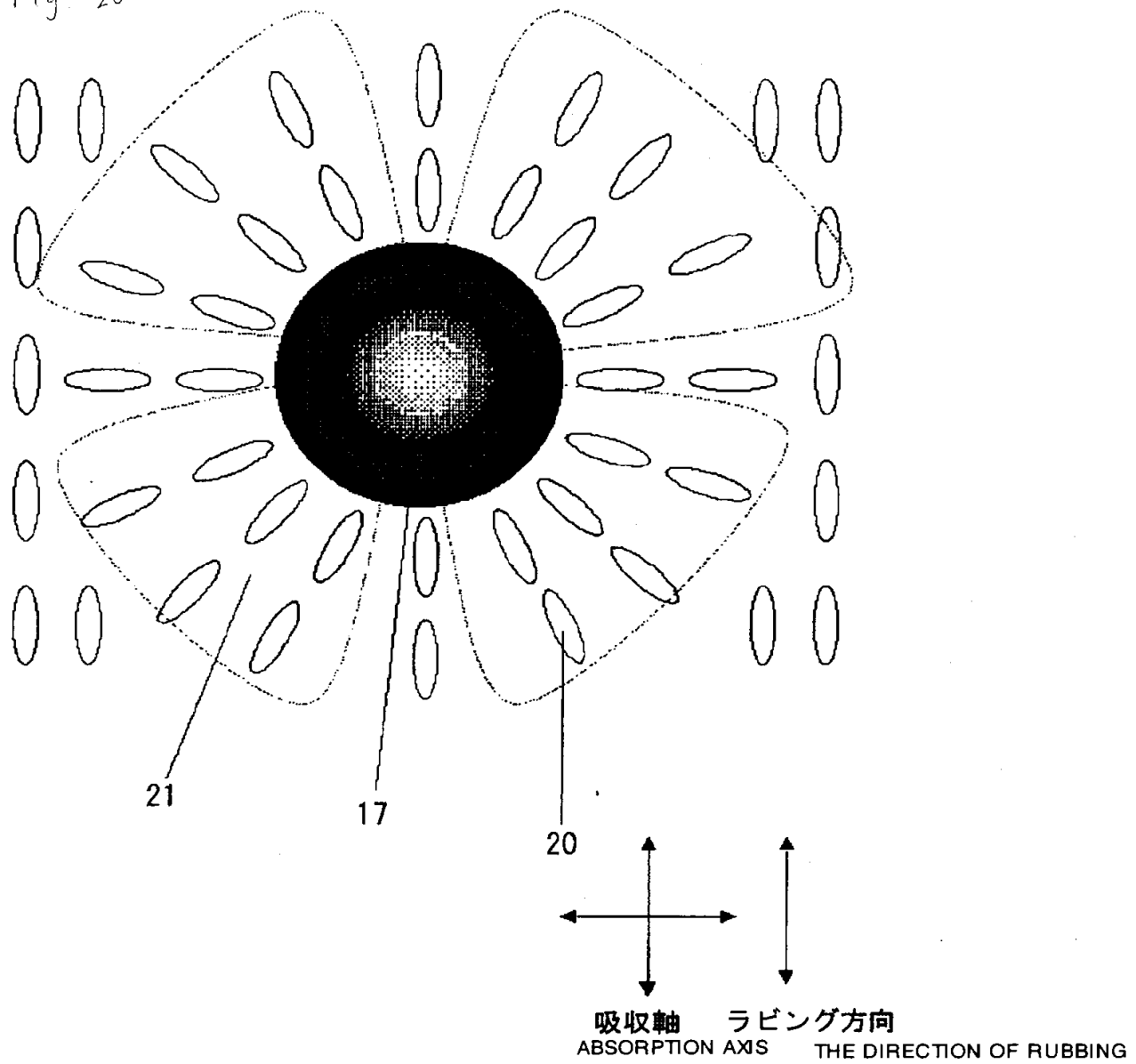


17 スペース 20 液晶分子 21 光漏れ

17 SPACER 20 LIQUID CRYSTAL MOLECULE 21 LEAKAGE OF LIGHT

【図20】

Fig. 20



17 スペース 20 液晶分子 21 光漏れ

17 SPACER 20 LIQUID CRYSTAL MOLECULE 21 LEAKAGE OF LIGHT

[Document Name] Abstract

[Abstract]

[Object] Spacers are prevented from moving to a transparent region even when vibration or impact is applied, which reduces leakage
5 of light and improves display quality.

[Solution] While a TFT side projection 6 is fabricated on a side of a TFT side glass substrate 10, a gap on a TFT side projection 6 is set narrower than a gap on a signal line 1, a scanning line 2, or a thin film transistor 3, spacers 17 arranged on the signal
10 line 1, the scanning line 2, or the thin film transistor 3 are made difficult to move to the transparent region even when pressure and impact are applied to a liquid crystal panel.

[Selected Figure] Fig. 3